The Only Journal With a Paid Circulation in the Rock Products Industry

Rock Products

Vol. XXV, No. 6 CHICAGO March 25, 1922

EDITORIAL DEPARTMENT—

Clinton S. Darling, Editor
H. E. Hopkins, Associate Editor

ADVERTISING STAFF—

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101 West 41st Street, New York City

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Western Representative

R. G. Symons,
Chicago Representative

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ROCK PRODUCTS—

Geo. P. Miller, Manager
E. M. Gibson, Assistant Manager

Published every other Saturday by

TRADEPRESS PUBLISHING CORP.,
542 South Dearborn Street, Chicago, Ill.

W. D. Callender, President.
N. C. Rockwood, Vice-President
Geo. P. Miller, Treasurer.
C. O. Nelson, Secretary.

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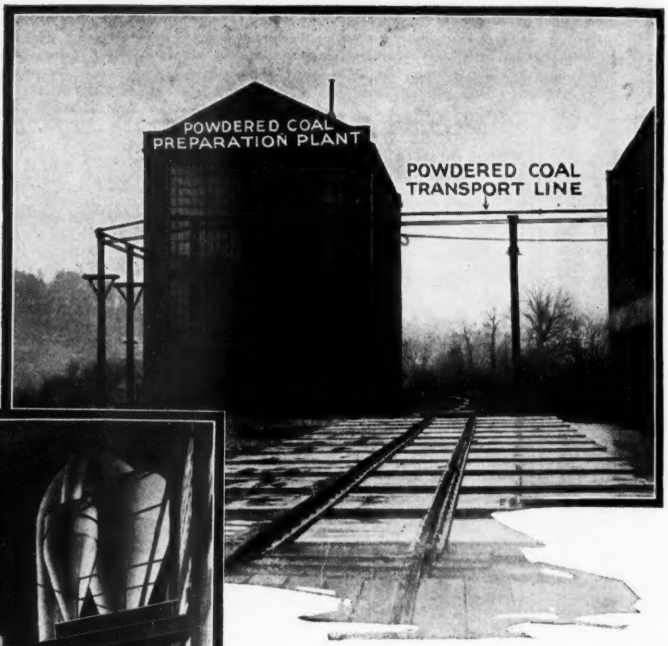

Interior of Powdered Coal Preparation Plant showing Dryer, Raymond Roller Mill with Air-Separation and Powdered Coal Transport Equipment.

More Than Two-thirds of Those Boiler, Copper, Iron and Steel Plants Who Employ Powdered Coal as a Fuel Use Raymond Mills to Do the Grinding

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THERE is need in the rock products industry for buildings that are ***engineered*** to each job; not "ready made" buildings but structures specifically designed for quarries, crushed-stone plants, sand and gravel pits, cement plants, lime plants, etc.

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A New Engineering Service

This means a new engineering service. We will bring to ***your*** building problem the advice of engineers of broad experience in your industry. We will supply all the steel and steel sash for the structure. We will give you or your contractor all the plans and specifications needed for the erection of the complete building. All this service ***costs you nothing.***

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Provides Service and Economy

Black ventilated mantle head

Ask the Texas Trap Rock Co.—

They will tell you of the necessary and periodical shutdowns that made their investment a precarious one before the use of Manganese Steel was suggested.

This quarry is composed of the hardest trap rock known in Texas—French Coefficient 24—and ordinary steel was unable to stand the wear and tear of this unusually hard, tough rock.

The No. 9 gyratory crusher illustrated above is equipped with a Black Type ventilated head, made of Amsco Manganese Steel, furnished by us.

Since the installation of this head, the operation of the crusher has been very successful, proving beyond all doubt that Amsco Manganese Steel will crush the hardest rock known.

If you have a crushing problem you will do well to consult with us

We are now prepared to furnish Rolled and Forged Manganese Steel Products and solicit your inquiries

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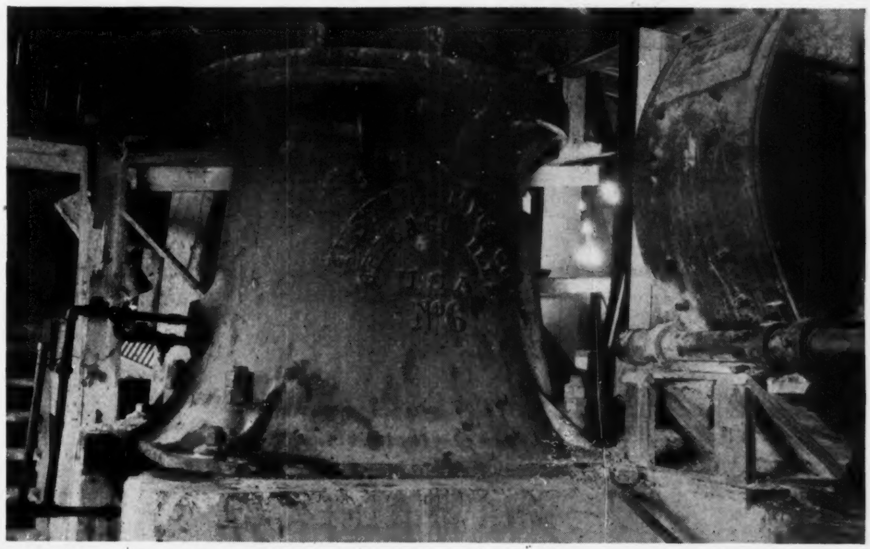
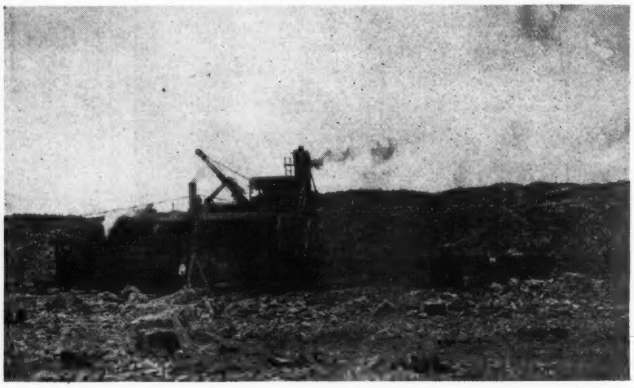
Plants: Chicago Heights, Ill. New Castle, Delaware Oakland, California

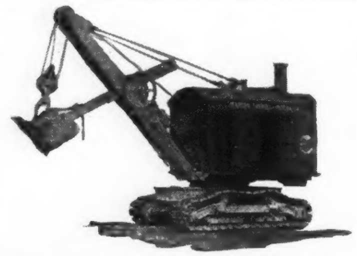




Model "50" Marion shovel which handles 1100 tons, per 10 hour day, of blasted flint rock in Buffalo Cement Co. quarry.

"After using 4 Marions for 12 years we have purchased a fifth."

Chas. A. Freiberg, manager, Buffalo Cement Co., Buffalo, N. Y., has this to say regarding Marion equipment:



This Model 31 Shovel is the latest addition to the Marion Equipment of the Buffalo Cement Co.

It carries a 1 cubic yard dipper (manganese front), is mounted on flexible crawler trucks and is readily convertible into dragline, clamshell or orangepeel excavator.

"We are well pleased with Marion steam shovel equipment and have always received good service and splendid treatment at the hands of the manufacturers. We are satisfied with the operating costs and can recommend Marion equipment to anyone operating quarries and doing grading work. We do not contemplate making any further purchases at this time as we have just purchased (January, 1922) a new Marion shovel, Model 31, caterpillar traction.

"The only comment which we believe is fair and just is that after using four Marion shovels within the past ten or twelve years we have purchased a fifth and were we in the market for any further equipment along this line we would give the Marion people the first consideration."

THE **Marion** STEAM SHOVEL CO.

Everywhere Reliable — The Marion Steam Shovel Co. — Established 1884

Established 1884 Marion, Ohio

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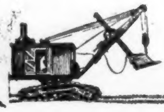

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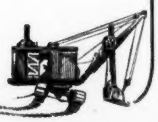


Rock Products

Volume XXV Chicago, March 25, 1922 Number 6

Where Good Storage Facilities Help Continuous Operation

The Keystone Gravel Company's Six Concrete Stave Bins, Holding 2100 Tons, Are Supported by a Reinforced Concrete Substructure with 33-in. Concrete Floor

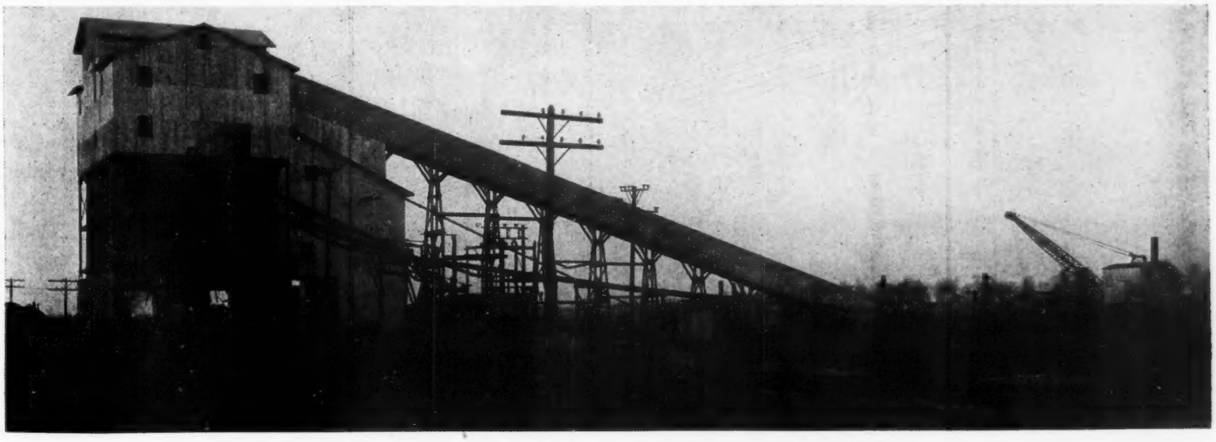
By Frank M. Welch
Chief Engineer, Greenville Gravel Co., Greenville, Ohio

THE plant of the Keystone Gravel Co. is located just outside of the city limits of Dayton, Ohio. Its design presents a different yet modern and efficient method of construction which from the standpoint of engineering, as well as of daily operation and appearance, has brought forth favorable comment from all who have visited the installation. This plant is situated on a belt line of the Baltimore & Ohio railroad which partially surrounds the city. It is in a position to handle city truck trade as well as rail shipments. On account of the truck trade it was deemed advisable to provide ample storage facilities, in order that by no chance would any unavoidable suspension in plant operation tie up a large job on which the company was furnishing the sand and gravel.

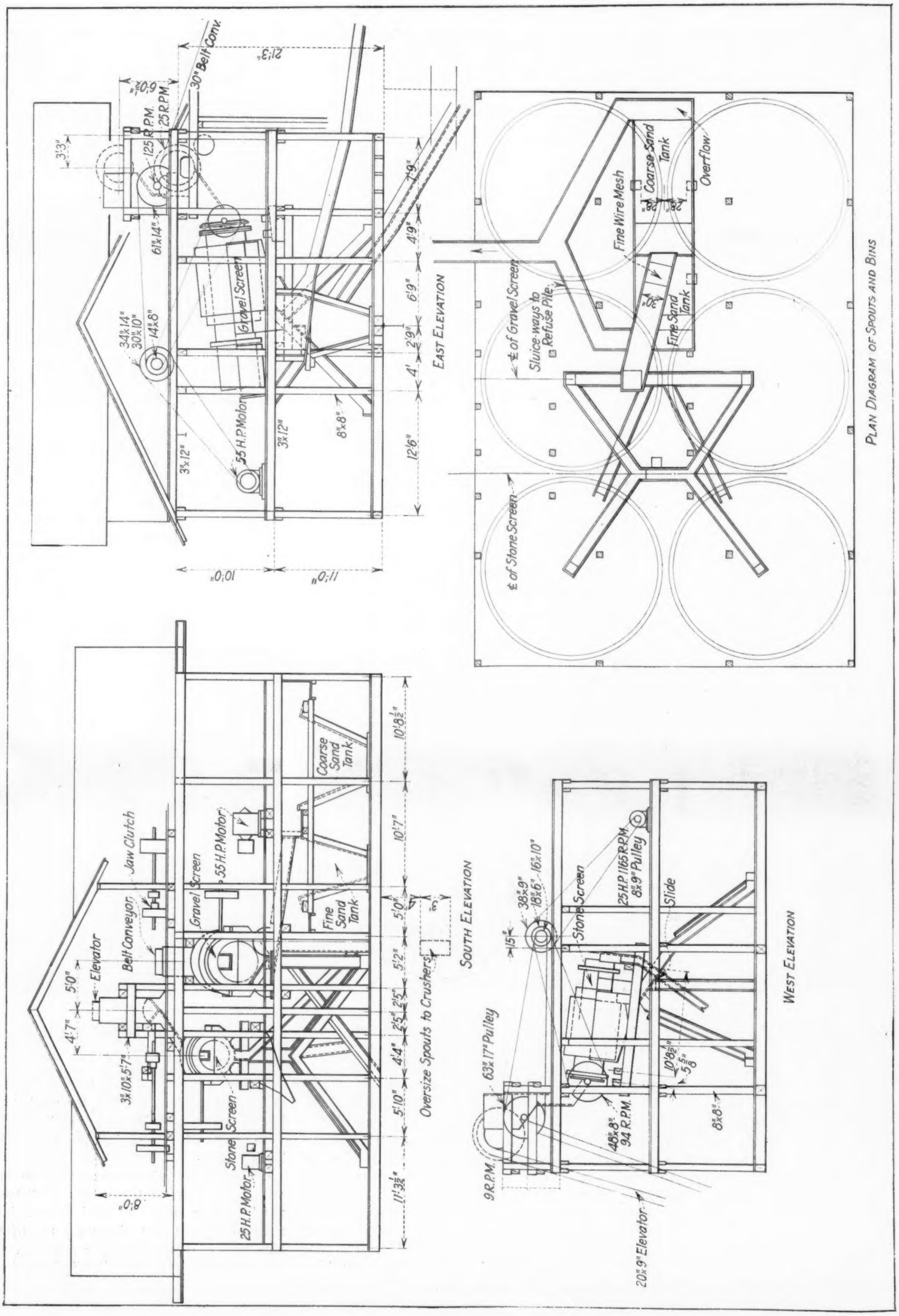
As shown in the accompanying illustrations, the plant proper and the bins are supported on a heavy reinforced concrete sub-structure. The reinforced concrete floor underneath the bins is 33 in. thick, necessitated by the enormous weight of material and bins. On this floor are set six circular bins 18 ft. inside diameter by 26 ft. deep, each having a capacity of 350 tons of finished product. These bins are of concrete stave silo construction, the outward pressure being taken by special iron bands placed at about 7-in. intervals.

Two circular, funnel-shaped gate openings through the 33-in. bin floor serve for loading cars underneath each bin. The two interstices formed between the main bins are also utilized for bin storage and each of these have similar gate openings, one over each loading track. All of the gate openings are lined with cast-iron thimbles, 12 in. in diameter at the bottom and about 4 ft. 6 in. in diameter at the top. These thimbles, which receive a great deal of wear, protect the concrete around the gates and can readily be replaced when worn out. Underneath the gate openings are standard sliding gates with levers for operation from trimming platforms. Side loading gates are also provided for each bin for truck loading on either side of the plant and are fitted with standard hinged loading spouts and sliding gates.

On the floor of the concrete sub-structure, with columns over the walls and between the bins, is a structural steel frame. This rises to a point just above the top of the bins, is well braced between the bins, and supports all of the machinery above, independent of the bins. This is floored over



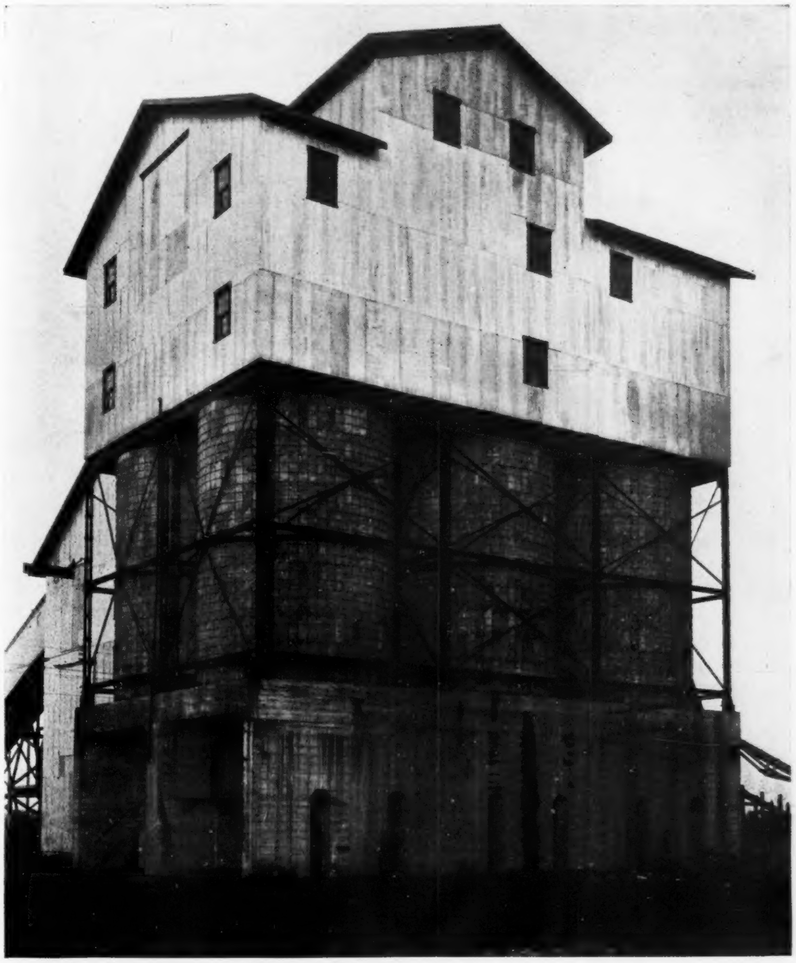
A MODERN PLANT WITH PLENTY OF STORAGE
Neat, compact, well-built, and efficient is the impression which this view of the Keystone plant gives. The housed belt conveyor carries material to the screens and crusher; through spouts the graded material goes to the storage bins and then is loaded into cars or trucks



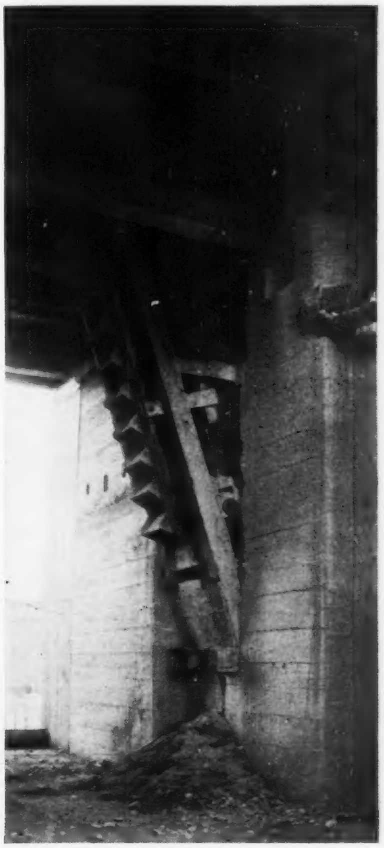
Some details of the main plant, showing how the stone and gravel screens are located, and the placing of spouts in relation to bins

the top and the entire washing and screening plant is here constructed, without any of the load or vibration bearing upon the bins or silos.

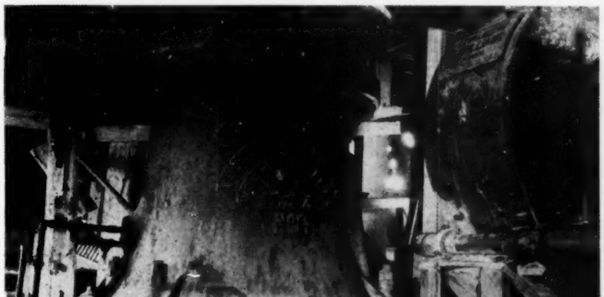
The gravel land which serves this plant is flat and on a level with the loading tracks. Inasmuch as water is reached about 20 ft. below the ground, and as a good depth of deposit lies below the water, it was decided to excavate with a pump boat. The pit being previously opened up at the far end of the property from the railroad, the boat will be built and launched at this point, where it will start digging and working its way toward the railroad. A pipe line supported on pontoons to the shore and over land to a large sump at the foot of the belt conveyor will convey the material to this point. A ditch will carry the bulk of the water back to the lake. In the center of the sump, which is about 200 ft. in diameter, is a McMyler "Whirly" which, fitted with a clamshell bucket, will pick up

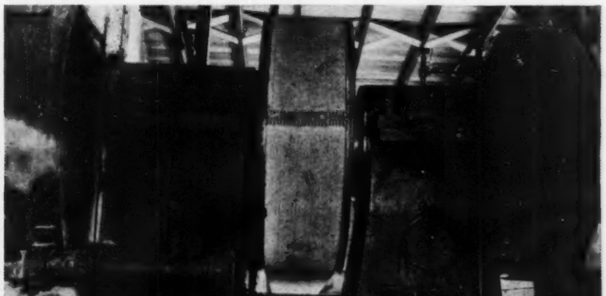


Sturdy reinforced concrete construction supports the six storage bins and the plant proper. Interlocking concrete staves with special iron bands every 7 in. form the storage bins, each of which will hold 350 tons of finished product

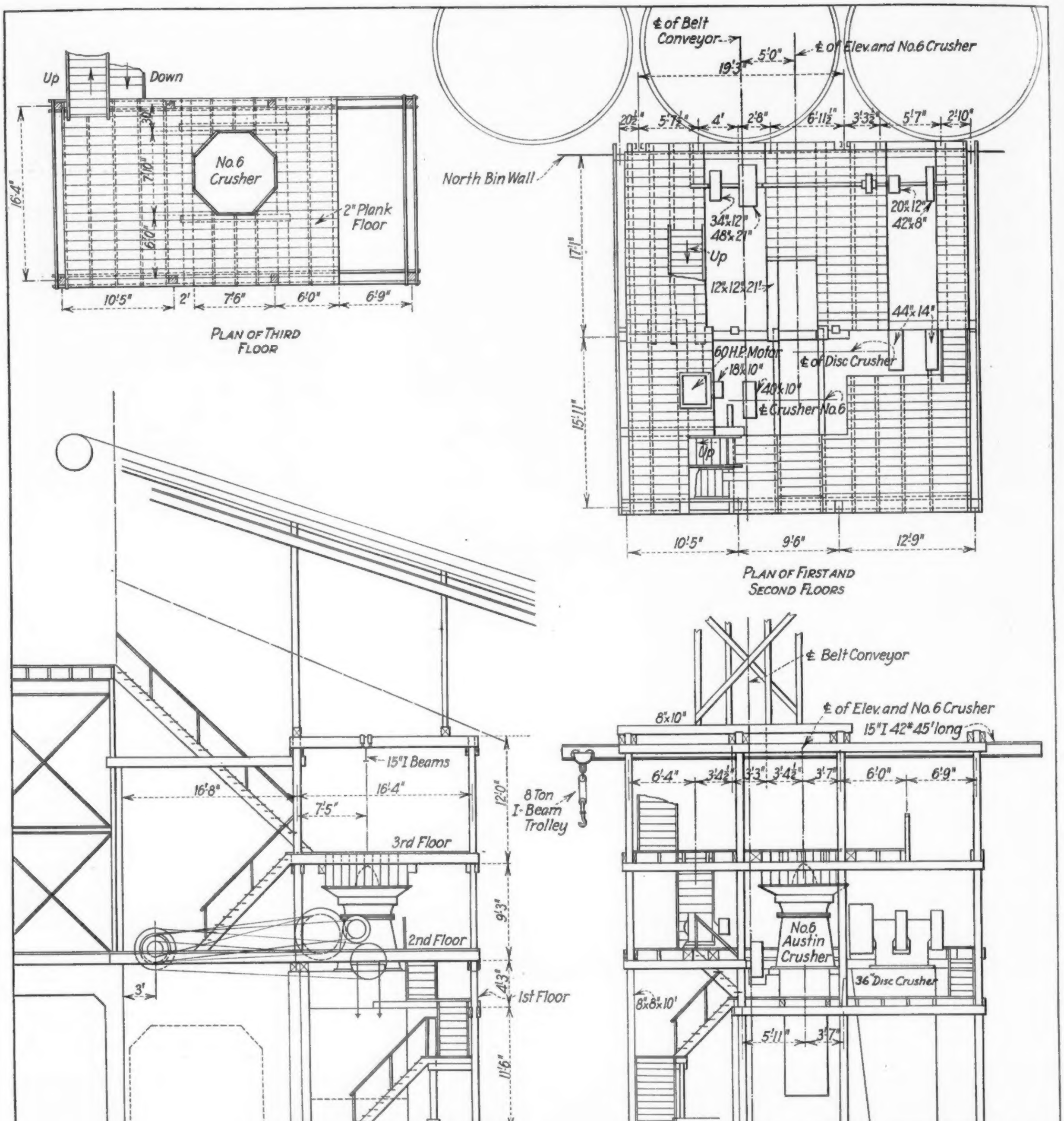


This continuous bucket elevator reclaims the stone from the two crushers shown below and carries it to the stone screens in the main plant above the silos. The buckets are mounted on a heavy steel thimble roller chain





Oversize gravel is spouted directly to the crushing plant on the ground. Both crushers, the primary at the left and the secondary at the right, discharge into a continuous bucket elevator which returns the material to the stone screen above

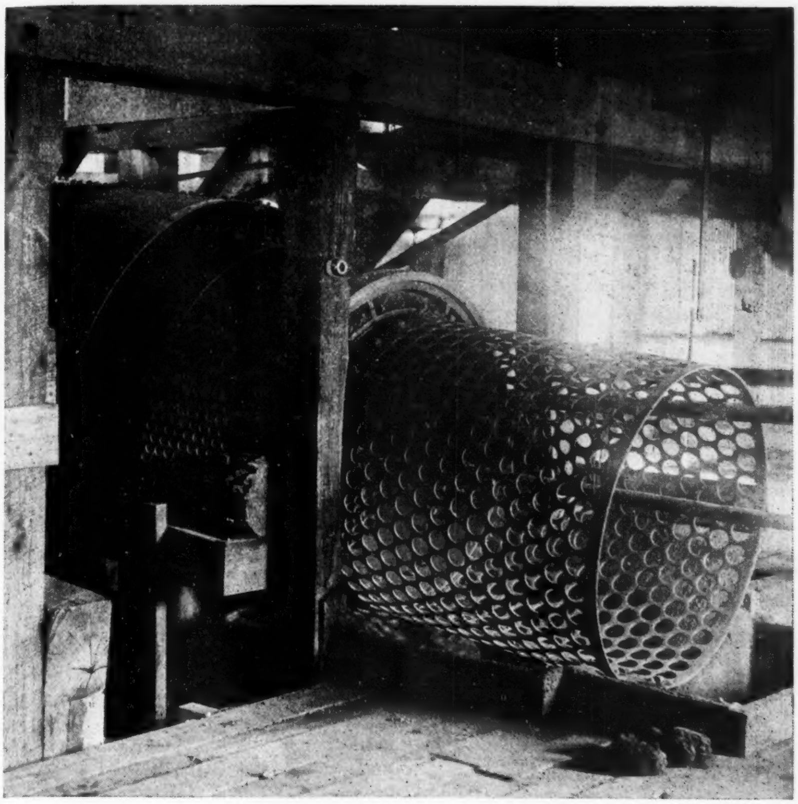


HOW THE CRUSHERS HANDLE OVERSIZE MATERIAL

On the ground below the belt conveyor and far enough from the main plant to permit trucks to be loaded through side bin gates, the crushing plant is located on concrete piers well up from the ground. Two crushers, a No. 6 gyratory primary crusher and a secondary 36-in. disc crusher, handle the oversize gravel and boulders which are spouted to them from the gravel screen. After crushing, the material is returned to the stone screen of the main plant by means of the continuous bucket elevator shown on the preceding page

the material which is pumped into the sump and load it into a large concrete hopper over the lower end of the belt conveyor. This clamshell operation is necessary in order that the sand and gavel may become mostly dewatered before going onto the belt conveyor.

The clamshell unit was installed this summer and in digging the sump has kept the plant going full capacity since that time with material within its reach. The pump boat was constructed this winter and will

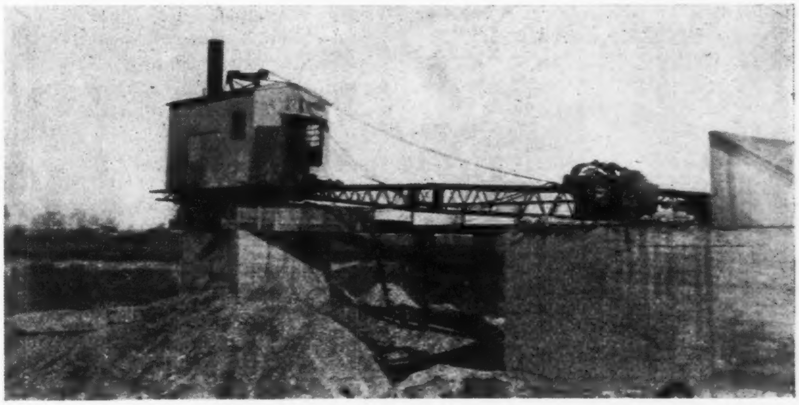


WHERE THE STONE IS GRADED
This triple-jacketed revolving stone screen grades the oversize material after it has been crushed and re-elevated. At the left of this, not shown, is a similar screen for the original gravel

be ready for operation as soon as the sump is excavated and ready to receive more material.

From the concrete receiving hopper the material is uniformly fed to the belt conveyor by a rotary feeder, driven from the tail shaft of the conveyor. A sliding gate also operates between the hopper opening and the feeder, which does not require constant attention of one man, but only needs adjusting when the boat passes from an extremely fine section of the deposit to a coarse one, or vice versa.

The belt conveyor, which is 30 in. wide by 243 ft. centers, carries the sand and gravel to the top of the main plant, where it is discharged directly into the main washing screen. This screen, which is 48 in. in diameter by 17 ft. long, is made up of three jackets, which produce two grades of gravel, concrete sand and oversize. The gravel sizes are spouted direct to their respective bins or properly mixed into one bin. The sand passes to a large settling tank where the clean sand is expelled through valves in the bottom to the sand bins and the dirt-laden water overflows the top and is sluiced away to a low spot in the property. In the main sluiceway between the screen and the main settling tank a hole occurs, which is covered with a piece of 1/10-in. mesh wire cloth. Underneath this hole a small settling tank catches fine sand and deposits it into one of the small bins between the circular bins to be sold as mason sand. This wire screen can be partially or entirely covered over, according to the amount of mason sand desired. The oversize gravel and boulders are spouted direct to the primary crusher in the crushing plant.



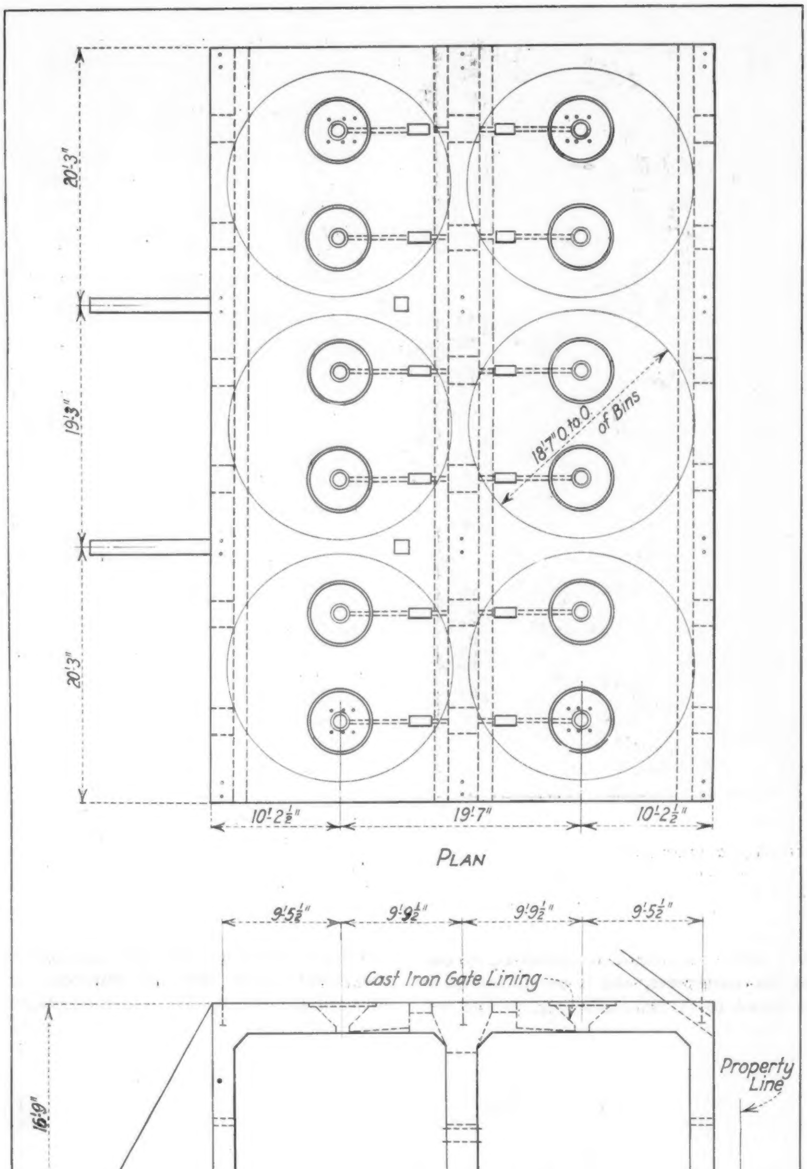
WHERE THE MATERIAL COMES FROM
Standing on its own legs—a reinforced concrete pedestal—in the middle of the sump, this "Whirly" with its clamshell bucket picks up material and loads it into a concrete hopper at the lower end of the belt conveyor

The crushing plant is on the ground, underneath the belt conveyor and far enough away from the plant to permit truck loading through the side bin gates. The crushers are set on concrete piers well up from the ground. The primary crusher is a gyratory and the secondary a 36-in. disc crusher. Both crushers discharge into a 20x9-in. continuous bucket elevator mounted on heavy steel thimble roller chain, which carries all crushed material back to the top of the plant and discharges it directly into a 36-in. diameter by 12-ft. long triple-jacketed revolving stone screen. This screen produces various grades of crushed material and the spouting arrangement underneath is such that the crushed boulders can be mixed with the screened gravel or can be stored in separate bins. All oversize from the stone screen is spouted down to the 36-in. disc crusher, from which it is again elevated and rescreened.

In the top of both the screen house and crusher house, heavy I-beams extend the full length and project at each end of the buildings. These beams are equipped with traveling I-beam trolleys and hoists which facilitate the handling of heavy machinery parts into the plants.

Because of the large storage capacity which has been provided at this plant, its operation can be made much more smooth and continuous. During a temporary lull the plant which is without adequate storage facilities must cease operations and lay off some of the men or pay them for being idle, while at a time when rush orders are on hand it is necessary to work overtime, subject both men and machines to unnecessary strain, and obtain less satisfactory results in the end. Costs, of course, are higher; customers are not so well satisfied; employes become disgruntled; and profits are smaller.

With storage bins like the ones provided at this plant, these disadvantages are overcome. Not only are men and plant kept uniformly busy during a dull



HOW THE LOAD IS CARRIED

Two thousand tons of products, besides the great weight of the plant itself, is no small burden. These details show how the plant is supported
Details of walls and floors for bins

period in producing for stock, but the material once produced and stored is conveniently available for either railroad or motor truck transportation. The only limits to speed of delivery are the speed of loading and the total capacity of storage plus production. It is not likely that a run will exhaust the stored supply and besides require material more rapidly than the plant can turn it out.

The entire installation was engineered and designed by the consulting engineering department of the Greenville Gravel Co., Greenville, Ohio. The screens, feeder gates and power transmission machinery were furnished by the Greenville Mfg. Co. of Greenville, Ohio, which is the maintenance department of the Greenville Gravel Co., and the elevator and conveyor by the Webster Mfg. Co., Chicago, Ill. The circular bins were furnished by Neff & Fry of Camden, Ohio.

Brick Made from Potash Byproduct

IT is sometimes forgotten that there are other types of brick equally as good as the burnt-clay, declares H. W. Charlton, chemical engineer of the Eastern Potash Corporation, and they are just as capable of standing the effects of time and exposure to the elements.

"There has recently been produced in the vicinity of New York," says Mr. Charlton, "a new brick which differs in many respects from any other previously known. This new product is called the 'K' brick and it will enter the market in huge quantities, 2,000,000 having already been used in building purposes.

"This brick is a byproduct in a chemical industry which sprang up during the war to meet the shortage of potash caused by the shutting off of the German supply. Potash exists in the extensive deposits of greensand in the Eastern coast states, notably New Jersey, and in its recovery a strongly cementitious material is obtained as a by-product. This, with the addition of sand and after proper treatment, produces a brick that for strength and weather-resisting properties resembles granite rock. The corporation, which holds the exclusive rights for the production of this material and has already manufactured over 2,000,000 brick, will in a short time be in a position to turn out large quantities at their new works at New Brunswick, N. J. Between $2,000,000 and $3,000,000 has already been expended in constructing this plant.

"One feature never previously known in brick manufacture, and which is characteristic of this product, is its peculiar green color. It is a well known fact that a light shade of green has a peculiarly soothing effect, and structures of this material have a softer and more restful appearance than is the case with red, white or yellow brick buildings."

Recommendation Against Sand and Gravel Freight Decrease

RECOMMENDATION against the decrease in freight rates on sand, gravel, and construction materials, sought for the Eastern and Central territory by the National Association of Sand and Gravel Producers, is contained in a tentative report filed with the Interstate Commerce Commission on March 14 by the examiner in charge of hearings on the matter.

Steps That Help Prevent Losses

Where a business exists on small profits it is the small gains or losses which determine its degree of prosperity. The accompanying discussion, which took place at the recent joint meeting of the Wisconsin Mineral Aggregate Association and the Illinois Concrete Aggregate Association, is filled with suggestions for preventing losses of half a dozen kinds. This article has valuable ideas on the subjects listed below:

When ownership passes
Rejection of material
Responsibility to purchaser
Kinds of contract
Allowable tax deductions
Accurate costs
Discounts and collections
Exchanging credit information

The March 11 issue contained papers from the same meeting on cost accounting, wages and hours, credits, terms, and discounts.

WHEN does the ownership of material vest in the purchaser? A man buys stone or sand or gravel from a producer and the producer ships it. At just what point in the transaction does the material cease belonging to the producer and become the property of the buyer? The following ideas are from men who have studied the subject carefully.

O. C. Hubbard, secretary of the Wisconsin Mineral Aggregate Association: Last year a case occurred in Wisconsin where a part of four cars of material was rejected by the purchaser. In one of these cars were about four yards, but the cars could not be moved because they had not been completely unloaded. About $400 car service had accrued up to that time.

In another case 17 carloads of sand had been unloaded by the contractor. He was taking aggregate and cement at two different points with only one inspector, and that inspector could not be at both places at the same time. The contractor needed the 17 cars of sand and had unloaded them on the right-of-way, then every one was rejected. Quite naturally the shipper had nothing to do with that and it is a question just where the ownership of the producer ceases and when that of the buyer begins. Should it be at the concrete road, or building, or place of construction, or should it be at the plant?

J. J. Sloan, secretary of the Wisconsin Granite Company: Is not that a matter of agreement? If I ship a car of material subject to certain specifications and after it arrives—even after it is partly unloaded—it is found to be poor, am I not as a man liable for that? If I agree to send material for certain purposes and I determine after its plant inspection that it is suitable for that purpose, don't I take the risk?

R. E. Wilcox, general manager of the Wilcox Company: In a case where we anticipate some difficulty in the material on arrival, we have made the shipper —provided that the sale was made f. o. b. plant—take the consignment. In other words, instead of showing ourselves on the bill of lading as the shipper, we say the consignee is the shipper, and in that way we limit our liability to the loading of the car. That might be a solution.

V. O. Johnston, president of the Lincoln Sand & Gravel Company: It is not a matter that has come within my experience as a shipper of sand and gravel to decide exactly the local status. We always take the position that Mr. Sloan has spoken of as being the correct one. We ship, for instance, material to one of our customers, and if on its arrival it is found to be unsatisfactory, we do not quarrel about the local phases of the situation, but we see that he is taken care of.

Specifically, however, it has always been my opinion that in the absence of a definite contract, the moment the railroad takes possession—assuming you were selling f. o. b. your plant—the ownership of that material changes, and while we often make claims for the customers for material lost in transit, it nevertheless is recognized as his material, and it is only a matter of trade courtesy that urges us to do that for him.

Ordinarily it is true that once the railroad becomes responsible for any shipment of material, it is the customer's material and not that of the shipper.

Different Ways of Selling

B. H. Atwood, president of the Illinois Concrete Aggregate Association: There are two or three different ways of making a sale. One is by warranty and another by sample, and another by letting the purchaser inspect the goods he is about to buy.

What is your contract on your gravel? Suppose it was represented that it was road gravel and would pass the inspection of the state inspector, then it becomes a question of giving the purchaser the opportunity of inspecting. It seems to me the title has passed, but is not the receiver of the freight entitled to see what you have shipped him?

It is physically impossible to inspect a car of gravel properly except to inspect it as it is being loaded or taken out shovel by shovel. It is not reasonable to expect anything else. In selling to anyone who might take an unfair advantage, you might say to the purchaser that this material will pass inspection and is in accordance with the specifications, and that it must be accepted or rejected upon arrival before demurrage accrues. Then he must look at the top of it, and take a guess at what is down below. You can stand on that technicality if you make that kind of a contract.

But you won't do that with contractors who want to be fair. If somebody at your plant, when the superintendent's back is turned, runs some bad material through and covers it up with good stuff, and later the bad is discovered on the job, you take care of a good customer on that. I believe you cannot make a general rule, but you can provide against much difficulty by requiring the carload to be accepted or rejected on arrival at destination.

Written Contracts or Verbal?

Should there be a written contract in the sale of sand and gravel? Producers are of divided opinions on that question, and a vote taken at the Wisconsin meeting showed the producers present to be almost equally divided. Discussion following the vote brought out these two opinions, one on each side of the case:

R. W. Scherer, of the Western Lime and Cement Company: I would want to qualify my vote on the subject of verbal or written contracts. If a verbal contract is made it is invariably our rule to confirm it by a letter to the customer, and in all my experiences in selling stone I never thought it desirable to sign a contract. In the first place there

are a number of things affecting a contract which are beyond your control; things that you can not adhere to. Then the contractor invariably over-estimates the quantity of material he wants. You sign a contract and bind yourselves to furnish so many cars when the contractor really does not need them.

One of the railroads on which we ship thought it advisable recently—on account of the winter shipments and the possibility of stone being rained on and freezing into the car, and rejected for that reason—to get a special guarantee from us to see that the material was unloaded.

The shipper always is responsible for any charges which accrue. If the consignee rejects the car, the railroad comes back on the shipper, and if you have not a bona fide customer you will have difficulty. In the case of some consumers who might be inclined to be slippery, to specify that such and such are the terms and conditions, and that ordering from the plant will constitute an acceptance of these terms should be sufficient. I think that will hold them, and I think you are much better off without a contract binding you to furnish a certain quantity.

A. A. Rothstein, of the Beloit Sand and Gravel Company: Adjustments can often be made to secure the acceptance of material which is subject to rejection. About three years ago I shipped 20 cars of gravel, and shortly after I shipped more, when I was notified that the gravel was rejected. I went to inspect the material and noticed some stone 3½ and 4 in. thick—very few of them, but nevertheless enough to give the right to reject it.

We came to a satisfactory arrangement. I had the material re-screened on the ground and we stood the charges. I went back to the plant and inspected our screen, and there was a big hole where this stone would pass. That contractor had a right to reject the material since it was the fault of our plant.

Now, when we make a contract that specifies or calls for a 2-in. gravel, we generally place in our contract, "Material approved by the sand and gravel company." The purchaser has the privilege of coming down to see the grade of material he is going to get, and when he sees it we will not stand for any rejection. If the worse comes to the worst, we will pay for the freight and sue him if necessary for the material.

I think a written contract is a very good thing to have. There are not many contractors who cannot estimate how much material they will use. They will not order 300 cars if they require only 250, and when they have a road job of 200 miles to build, they know about how much sand and gravel they will need. They will tell you they will need approximately 3000 yards of sand and 6000 yards of gravel, which may be 100 yards out of the way one way or the other, but I find I have never had any trouble with contractors where I have made contracts with them, if the man is any kind of a reliable contractor. If he is not, nobody wants to sell to him.

Lowering Taxes by Deductions

J. J. Sloan, secretary of the Wisconsin Granite Company: On the question of accounting depends cost, and upon the question of costs depends selling price, and upon selling price depends whether we are going to lose money or not.

There are a great many elements which have never been considered as cost, before a system of cost accounting was installed. Are you aware that the government allows on crushed stone 1¼ cents depletion? Taking a producer who gets out half a million tons each year, the amount which can be witten off for depreciation is unexpectedly large. How many have taken the 5 per cent on buildings and the 10 per cent on pit and quarry crushing equipment? Those are specific items. Then you have the item of obsolescence on which you are allowed a tax return. These items, when set down on the books, become a definite charge. How many men figure a production of three times what their overhead is going to be, but when they get out only one-third or one-half and their overhead per ton or per yard is greatly increased, increase the overhead charges accordingly?

Some men will figure a stripping cost of $5 or $10 on a 10-foot bank. When they get half-way in they find it is half clay, and they figure on a 12-foot bank and the stripping cost is doubled. There are a thousand and one instances of that in every day operation of either a quarry or a pit.

J. K. Jensen, president of the Wisconsin Mineral Aggregate Association: The fact should not be lost sight of that accounting has another phase than the one which has to do with sales price. There is a very important relation to taxes, if we are fortunate enough to have to pay an income tax. If a man does not take his depletion and depreciation to which he is entitled, it means more taxes.

Another item which can be charged off is a reserve for bad debts. The govern-

Total Cost of Plant, Including Land, Machinery, etc.		$150,000
Annual Capacity of Same Plant		200,000 Tons
This plant with a cost of $150,000 and an annual production of 200,000 tons, which tonnage sold at 75c per ton, represented in sales an amount equal to		$150,000
The cost, IN THE OPINION OF THE PRODUCERS, was 40c a ton or a total of		80,000
Leaving them, THEY BELIEVED, a net profit of		$ 70,000
While they had sold 200,000 tons at 75c per ton, totaling		$150,000
Their general overhead, consisting of office salaries, office expenses, depreciation of equipment, etc., amounted to 14c per ton or		28,000
Leaving		$122,000
Their productive overhead, consisting of superintendent's salary, depletion of real estate, etc., amounted to 4c per ton or		8,000
Leaving		$114,000
Their stripping, consisting of stripping salaries and wages, etc., amounted to 5c per ton or		10,000
Leaving		$104,000
Their labor, power and repairs amounted to 39c per ton, or		78,000
Leaving a profit of on which income tax should have been paid.		$ 26,000
But, not keeping a cost record, they paid income tax on an imaginary profit of $70,000 or		
Federal Excess Profit and Income Tax of	$43,000	
State Income Tax and Soldiers' Bonus of	7,540	50,540
Leaving a deficit of		$ 24,540
It must be remembered that they could have made $10,500 on the original investment of $150,000, by investing in any good 7% collateral.		

GUESSING OR KNOWING?

After the producer had paid taxes on his estimated profit of $70,000, as shown above, his actual loss was $24,540. Accurate cost figures showed his profit to be $26,000, or about half the tax he paid

ment now permits that, and the man who does not know that and does not take advantage of it is paying more taxes than he needs to pay, and he is fooling himself most if he does not do that.

A Practical System of Cost Accounting

J. D. Pierce, secretary of the Illinois Concrete Aggregate Association: The Illinois Concrete Aggregate Association is about to publish a manual which will be a pamphlet of 40 to 50 pages. You might think that is a complicated thing, but if your bookkeeper will take that book and read it through, he will find—provided he is a high-grade, good bookkeeper and understands his business thoroughly—that about three-fourths of it is exactly the way he is already doing it. If he is not so experienced, or if, as often happens, it is a girl bookkeeper who has not had any great deal of training, she will find much there to study, and this book will be a great help to her. This book is a complete statement of every detail of handling the accounts from A to Z, and when you get it you will know what we are driving at.

Estimated Profits May Be Losses

O. C. Hubbard, secretary of the Wisconsin Mineral Aggregate Association: We recently prepared a hypothetical and satirical statement of an imaginary plant which cost $150,000 with a 200,000 ton production. The company sold its material at an imaginary good price, and figured in their minds, without any books or anything, what it cost to produce and what the profits were. The company paid an imaginary income tax on the imaginary profits. The statement (shown on the preceding page) of the estimated figures, and the same conditions shown by accurate cost figures, shows how cost accounting is necessary to show a producer where he actually stands.

How Discounts Aid Collections

I. M. Clicquennoi, general manager of the Wisconsin Sand and Gravel Company: Up until three years ago we had no particular method of discount. I am connected with three plants in three different locations, and we had printed at the top of our invoices: "Thirty days net; 2% cash 10 days," and I would have fallen dead if a man had paid his bill inside of 30 days. In all these years that I have been connected with those businesses, only two men have taken the 2% discount. The contractors took it upon themselves to hold us off until Christmas; just before Christmas they would call us in and say, "Well, we have settled up with everybody else; here is your check," and we got all our collections in.

About three years ago we decided to change our methods. We did not call the differential sum a "discount;" we called it a "penalty." Our price, we will say, was 80 cents a ton, and we added 5 cents, making it 85 cents a ton. Then we gave in our case, 15 days from the time the invoices were rendered in which to accept the discount. It was a little troublesome at first. Our contractors thought they could wait until Christmas and still take the lower price, but when Christmas came we "stood pat," and insisted on our full price. After making an example of three or four men we found that the men who used to hold us off until Christmas would call us up on the last discount day—we marked our invoices the same as the telephone company or the electric light company, "Last discount day on the 25th,"—and say, "We cannot get our check over there until tomorrow; will that be all right?" Our money absolutely comes in, and the good contractors agree with us, because it puts a penalty on the "fly-by-night" contractors. That 5 cents extra per ton adds a penalty which he has to pay if he cannot pay his bills on time, and the man to whom we want to sell is favored to the extent of 5 cents a ton.

Exchanging Credit Information

B. H. Atwood, president of the Illinois Concrete Aggregate Association: It not only puts a penalty on the "fly-by-night" contractors, but it pretty nearly does away with the necessity of credit interchange information. We have a credit interchange in the Illinois Association. A member desires to know anything about a purchaser, and he writes to the secretary, who sends a questionnaire to the members of the association, asking for a report of experiences. That comes back, and everybody who has furnished information is told what everybody else has reported. In one specific case one of our shippers saved quite a loss by making use of that credit bureau. We found that the contractor was purchasing from him mostly because he had worked his credit to the limit with somebody else, and he found it out after having shipped only one or two cars on a big order, so he discontinued shipping on a credit basis.

There are several questions on the subject of discounts. One is as to when payment should be made. We had in Illinois a discount system of 5 cents a ton for cash in 10 days from the date of the bill on carload business, and the bill was presumed to be dated the day the shipment went out, or as soon thereafter as it could be gotten out, and that brought the money in very steadily and satisfactorily. There was some complaint, however, and not without justice, because if a man is obliged to pay in 10 days all his bills he is not being carried by the shipper at all; and since business is built on credit, perhaps he should have 30 days, and then a discount for prompt payment, or a penalty for the man who does not pay promptly.

Wisconsin Breaks Cement "Boycott Agreement"

IN order to prevent the "loss to industry and labor" that would result from holding up its road building for a further decrease in cement prices, Wisconsin has determined to buy its cement at the prices recently offered.

This step is regarded as a break in the "boycott agreement" recently entered into by five states in the Middle West, joined later by three others. These eight states agreed to buy no more cement until they could get it at $1.30 a bbl. Wisconsin has obtained 400,000 bbl. at this price from the Marquette company—which also sold 600,000 bbl. to Illinois at that figure—but Wisconsin needed 1,500,000 bbl. for its 400 mile program for 1922, and the next best offer was $1.41.

"The state has carried the fight as far as it is profitable to carry it and any saving in the price which might result from a continuance of the boycott will be far outweighed by the loss to labor and industry," said Chief Engineer Hirst.

Iowa Association to Give Cost Analysis Service

ONE of the main activities of the Iowa Sand and Gravel Producers' Association, writes Field Secretary Loughead, will be a cost analysis service. This analysis will be gathered by the association and accumulated and distributed to members in the form of averages for particular districts and the state as a whole.

At present the association is conducting a membership campaign and hopes to have enlisted at least a 90 per cent representation of the total production of the state.

Mr. Loughead has postponed his Pacific coast trip and will do some work for the Georgia-Alabama association which is being organized.

Policy as to Open Price Associations

MISUNDERSTANDING appearing to have arisen over the recent correspondence between Secretary of Commerce Hoover and Attorney General Daugherty regarding the particular character of trade associations with which the Department of Commerce could rightly continue to co-operate in statistical and other matter of commercial advancement, Mr. Hoover has issued a statement saying that the department makes no interpretation of the Sherman law. It does have to decide in what sort of association work it can rightly co-operate, Mr. Hoover said, but the department does not find a basis of co-operation with the so-called open price association, and never has.

Lime Burning in the Rotary Kiln

An Authoritative Description of This Newest Lime-Burning Process, With a Consideration of Costs in Addition to the Technical Points Involved

By Arthur E. Truesdell
Consulting Engineer, Pittsfield, Mass.

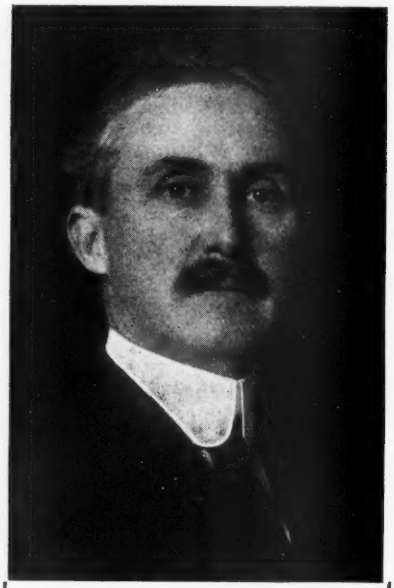
THE rotary kiln process for burning lime is so radically different from all other previous processes that it is a question whether it would ever have been introduced but for the success of the kiln in burning portland cement. Natural cements burned from lumps of rock were easily handled in shaft kilns similar to those used for lime. When, however, the raw cement materials had to be reduced to a powdered condition in order to secure the intimate mixture essential to portland cement manufacture, a new element was introduced. The powdered raw material must now be wet, molded into bricks and the bricks semi-dried before placing in the kiln. As this involved much extra labor and time, experiments were begun with a rotary kiln, for the raw material in this case could be introduced into the kiln directly after mixing and burned, either as a dry powder or a wet slurry.

Although Siemens had patented his revolving furnace in 1869 and such furnaces were in use in the alkali works, the proposal to use the device in the manufacture of portland cement originated in England with Crampton in 1877.[1] His ideas were not tested out, but in 1885 Ransome patented a kiln and carried out extensive experiments with a 25-ft. cylinder. He was followed by Stokes, who increased the length to 35 ft. These workers were unable to overcome the sticking of the fused clinker to the lining of the kiln, although some of their ideas worked out satisfactorily. They seem to have been so anxious to secure a phenomenal success that they attached heat-conserving and mechanical handling devices to a kiln which had not been worked out in its simplest form.

Meanwhile the manufacturers of portland cement in this country had been following the European practice. They found a handicap, however, in the much higher cost of labor here and turned to the English rotary idea, notwithstanding its high consumption of fuel per barrel of cement. Navarro, at Coplay, Pa., continued Ransome's work, carrying it to an entirely successful issue on dry raw materials. Giron, with the Atlas company, also finally solved the difficulty in burning wet slurry by using a long kiln.

The early experiments for the recovery of heat from clinker and stack gases had been so discouraging that such devices (with the possible exception of some simple device for heating the air for combustion by the hot clinker) were for a long time looked on with disfavor. These devices did not seem so necessary with the longer kilns as developed by the Americans. Although trials were made on kilns 90 ft. long, the popular size for dry materials became 6 ft. in diameter by 60 ft. long.

Some limestones are so soft or so highly crystalline that heating makes them very tender. Heat applied suddenly, especially to such as carry a good percentage of moisture, tends to break them apart and in many cases they will disintegrate if moved when at a temperature of 700 deg. C. or over. This action clogs the draft, so making the proper burning of this limestone difficult in a vertical kiln. It was evident, though, that if a rotary kiln could successfully burn cement—which requires a higher temperature than lime—it ought to burn either hard or soft crushed limestones.



PROBABLY few if any men in the United States are better qualified to discuss lime manufacture than Arthur E. Truesdell. He grew up in the New England lime business. He installed the only two rotary-kiln lime plants in New England, those of the Vermont Marble Co. (Vermarco Lime Co.) at West Rutland, Vt., and the New England Lime Co. at Adams, Mass. He has had many years' experience operating both shaft and rotary lime kilns, and he has been consulted concerning the problems of many others.

Whether or not the crystalline calc spar at Colton, Calif., was of this nature, the fact remains that the Southern California Portland Cement Co. tried the crushed calc spar in its rotary cement kilns around the year 1899, which is the earliest use of the rotary kiln on lime known to the writer. The main data reported of these tests are:

Size of kiln, length, 70 ft.; diameter, 6 ft. for 30 ft.; 5 ft. for 40 ft.
Size of stone fed, under 1¼-in. and over ⅜-in.
Character of stone, crystalline calc spar, 98.5 $CaCO_3$.
Character of fuel, crude oil.
Output of lime, 25 tons per day.
Fuel consumption, 1680 gal. per day.
Fuel ratio, 67.2 gal. per ton of lime.

The lime was of excellent quality and found a ready market. They tried powdering the rock, but encountered so much hot oxide dust that they gave up the idea and thereafter rejected all stone under ⅜ in.

These results were not generally known to the industry nor the earlier ideas of Mathey as given in his patent in 1885. It remained for John G. Jones to introduce the kiln in the East through his unbounded energy and the demonstration that he was able to make at Natural Bridge, N. Y., around 1905. Although the Jones patent (No. 832485—1906) has restricted claims and stands on questionable ground in view of the history of the art, yet the industry owes much to him for his early work. By 1910 the New England Lime Co. had in operation at Adams, Mass., a 6x100-ft. kiln designed by him. This kiln was an unquestioned success on soft crystalline marble, which had been hitherto burned in pot kilns, although many attempts had been made to use the vertical shaft kiln. This kiln has been followed by many other installations in various parts of the country, some of whom have paid no attention to the Jones patent.

The Kiln

The rotary kiln in its simplest form and as usually installed consists of a steel

[1] Redgrave and Spackman, "Calcareous Cements," page 167, 1905.

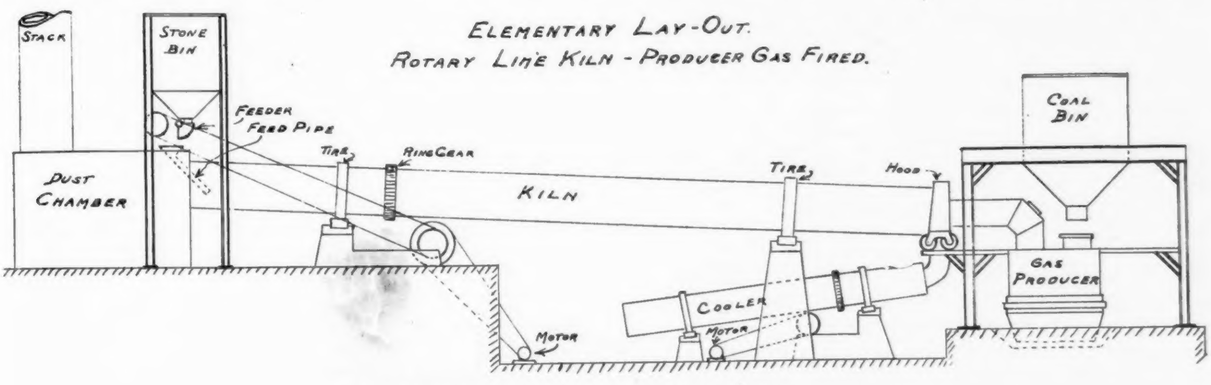
shell 6 to 8 ft. in diameter and 100 to 125 ft. long, supported at a slight angle to the horizontal by two sets of rolls. As the shell is lined with firebrick and carries, besides, the charge of limestone, it must be very rigidly built in order to support the weight. For this reason the longer kilns should be of the larger diameter. The upper end of the kiln connects with a chamber for the recovery of dust and beyond the chamber in turn is the stack for the production of the necessary draft through the kiln and chamber.

will carbonize; cases having been noted where the panes of glass on cold frames were coated so densely that a knife or acid had to be used to remove the encrusted carbonate. There are several ways of removing the dust from the stack gases, and eventually all plants near centers of population will be equipped with such devices.

Raw Material Bin

Over the dust chamber is a bin from which the prepared raw material is fed

After some experience, the kiln man will note with most stones (especially if in small sizes), that in burning they will ride differently on the side of the kiln when raw than when calcined. Thus it will be seen that the most important man on the job is the kiln man, whose work is light, but requires experience, good judgment and reliability. If he has no other duties, he can care for two or even three kilns. In the one-kiln plant he generally looks after the oiling of the kiln, the cooler, and their motors.



In its simplest form a rotary lime kiln has these elements

The dust chamber should have baffles and sufficient sectional area so that the dust-laden gases become much reduced in velocity, thus allowing gravity to deposit the heavier dust in the bottom of the chamber, from which it may be removed by a screw conveyor or otherwise. Sometimes, where the draft is strong in the chamber, the hot dust drifts into hard masses like packed and drifted snow; it cannot be easily removed. A case occurs to the writer where a foreman, in attempting to dislodge some of this hot material in a dust chamber with rods, was fatally burned by a cave-in. Dust conditions and behavior vary greatly at different plants. Some stones dust more in the process than others. Some operators claim that combustion is greatly hindered at their plants by excessive dust in the combustion air drawn through the cooler. Others have no trouble on this score; or, if they have, they do not know it. In some cases, the lime dust cakes around the lining in the kiln at a point about 25 ft. from the lower end, thus cutting down the effective area and the capacity of the kiln. These "rings," which may be 9 to 12 in. thick before opportunity offers to remove them, are caused by eddies in the draft.

All rotary kilns throw off more or less dust from their stacks, and in some cases create a nuisance in the community. The finer particles will float for a distance of ½ mile or more before settling, thus covering houses and vegetation with a white powder. If undisturbed, this lime dust

to the kiln. An adjustable feeder actuated through the kiln gearing feeds the stone through an inclined pipe to the interior of the revolving kiln. As the speed of the feeder harmonizes with the speed of the kiln, an even burden is maintained in the kiln, independent of its speed. The amount of this burden or load can be changed by changing the feeder adjustment. The feed pipe, if not properly designed for the conditions, will give trouble, due to sagging under heat. Short and hot kilns are hard on them and require special attention to their design and installation.

Judging the Heats

Near the upper tire of the kiln is the gear ring by which it is turned. Meshed to this is a train of gears actuated generally by a variable speed motor so as to give a kiln speed of anything from ⅕ to 1 r.p.m. The kiln speed, of course, controls the rate of travel of the raw material through the kiln; so that by simple lever control the kiln man is able to push the stone through fast when the heats are high or delay the stone when the heats are low. In cases (as in producer gas firing) where he has limited control of the heat, this speed control is the kiln man's most important duty. When to change the speed, and how much to change it, are matters for his judgment, and are decided by him after inspection of the lime coming through, its appearance in the kiln and the heats in the kiln. The heats are judged roughly by color.

The Kiln Shell

The shell of the kiln is attached to and supported by two steel tires placed at about ⅕ of the kiln length from either end. These tires run on steel rolls having adjustable bearings so that their axes may be set out of parallel with the kiln axis. As the kiln runs at an inclination of about 4½ per cent it has a tendency to slide down hill in the direction of its axis. There are generally stops provided to prevent it running off the rolls, but these are for emergency use. The rolls should be set so that by their motion they tend to run the kiln up hill. This will counteract the tendency of gravity in the opposite direction. As such a position of the rolls means a slight slipping on the rolling surface, care must be taken that all rolls are set at the same angle, to prevent excessive wear on any single roll. It always pleases the kiln man to have his kiln running absolutely clear of the stops and steady as a clock from day to day.

The lower end of the kiln is covered by the stationary hood through which the fuel is introduced and the lime drawn. The hood is mounted on wheels so that it may be drawn back clear of the kiln to allow inspection and repair to the interior of the kiln.

The lining of the kiln is more or less a matter of choice. If the heats are not very high, the kiln may be lined with blocks of the firebrick that we have preferred in our shaft kilns: but in cases where 1 in. and larger sizes are to be calcined, it is preferable to use silica brick

on account of the high heats necessary—that is, in the lower 20 ft. Ordinary brick in this place under high heats do not last over three to five months, thus requiring replacement every few months. Such an expense for repairs and loss of capacity is not ordinarily justified. Silica brick should go twice as long, if carefully handled. These brick form a heavy glaze of 1 to 1½ in. thick and do not contaminate the lime, as might possibly be expected. As they are very brittle, the kiln must be heated very gradually in order to prevent excessive breakage when starting up. They have a high co-efficient of expansion so that in installing they should be backed with a flexible, non-combustible material, such as asbestos or mineral wool. This backing will also cut down the heat losses from radiation. A case is in mind where the silica brick was installed without backing, which split the kiln shell along a longitudinal seam for 15 ft., when the kiln was started.

From the lower end of the revolving kiln, the lime drops through an opening in the lower part of the hood into a chute leading into the cooler. This is an unlined steel shell similar in shape to the kiln and similarly mounted. The cooler has shelves which lift the lime and allow it to drop in its passage through the cooler and so to become cooled by the draft of air passing through on its way into the kiln. This air is that used to maintain combustion and is drawn by the pull of the stack through the cooler, kiln and dust chamber in succession. Thus drawn through the cooler, it carries the heat of the discharging lime back into the kiln, improving to some extent its economy. Coolers are generally from 4 to 5 ft. in diameter and from 35 to 50 ft. in length, and driven by a constant-speed motor. It requires no attention beyond setting the rolls and oiling. From the lower end of the cooler the lime drops into suitable conveyors and is ordinarily deposited in bins, from which it is drawn for shipment or hydration.

Operating Costs

The cost of lime made in rotary-kiln plants varies the same as it does in shaft-kiln or other plants; the nature of the raw material as to size, porosity and chemical composition; the fuel used and how utilized; labor efficiency and handling devices—all modify the costs. It may be instructive to discuss the items somewhat in detail, under both favorable and unfavorable conditions, for an 8x125-ft. kiln heated with producer gas, electrically driven, and turning out 60 to 75 tons of lime each 24 hours for 300 days during the year. We will state the conditions first and then summarize:

Labor — Favorable conditions: 12-hr. shifts; 2 kiln men, 2 producer men, 1 helper for 6 hr., 2 crusher men for 9 hr. Wages, 30 cents per hour. Unfavorable conditions: 8-hr. shifts; 3 kiln men, 3 producer men, 1 helper for 6 hr., 2 crusher men for 8 hr., 1 crusher man for 4 hr. Wages, 50 cents per hour.

Fuel—Favorable conditions: Finely sized, easy burning magnesia stone; hot gas; coal, gas quality, costing $5 per ton at the furnace; 4½ lb. of lime per pound of coal. Unfavorable conditions: Raw material in ½ to 1½-in. sizes; hard burning, high calcium stone; cold gas; coal, low volatile, coasting $8 per ton at the furnace. Fuel ratio, 2 lb. of lime per pound of coal.

Supplies—Oil, grease, waste, etc., taken at $6 per day for both conditions.

Power—Favorable conditions: Electricity at 1 cent per kw.-hr., 10 kw.-hr. per ton of lime. Unfavorable conditions: Electricity at 2 cents per kw.-hr., 15 kw.-hr. per ton of lime.

Maintenance and Repairs—Favorable conditions: Low heats. Taken at $6 per day. Unfavorable conditions: High heats. Taken at $9 per day.

Burden—Favorable conditions: Low investment, due to favorable location, economic design, etc.

Invested in—		Interest at 6% ..	$5,400
Machinery	$36,000	Depreciation—	
Kiln	24,000	10% on machinery, 8% on kilns, 4% on buildings	6,720
Steel building..	30,000	Taxes, 2% on $40,000	800
	$90,000	Insurance, 1% of $60,000	600
		Total	$13,520

Per operating day is $45.07

Burden—Unfavorable conditions: High investment, due to poor location, bad design, etc.

Invested in—		Interest at 6%..	$6,000
Machinery	$36,000	Depreciation—	
Kiln	24,000	10% on machinery, 8% on kilns, 4% on buildings	6,720
Buildings, etc.	40,000	Taxes, 2% on $50,000	1,000
Total.............	$100,000	Insurance, 1% on $70,000	700
		Total.................	$14,420

Per operating day is $48.07

SUMMARY—BURNING COSTS PER DAY

	Favorable cond. output, 75 tons	Unfavorable cond. output, 60 tons
Labor	$21.60	$37.00
Fuel	83.00	240.00
Supplies	6.00	6.00
Power	7.50	18.00
Maintenance and repairs..	6.00	9.00
Burden	45.07	48.07
Total, burning costs per day	$169.17	$358.07
Total, burning costs per ton	2.25	5.97
Limestone, 2 tons, man-size	1.20	2.50
Cost of lime in bin, per ton	$3.45	$8.47

It will be seen at once that the important cost items are labor, fuel, and burden, of which the largest, fuel, runs from one-half to two-thirds of the total. Labor costs run lower than in shaft-kiln plants per ton of lime, although there is a tendency in these plants to reduce this cost by installing mechanical devices.

Importance of Burden

Burden is an item often lost sight of in the initial enthusiasm of building a new plant; but after 10 years of operation, the inevitable depreciation becomes self-evident and our owner notes also the taxes and insurance he has paid and possible interest lost. How much better to provide for these items in advance by including them in the operating budget where they belong. As the rotary plant is largely mechanical, its original cost and resulting depreciation are nearly double that of the vertical shaft plant of the older type. Some of the later designs, however, of these kilns, incorporate mechanical features, which add considerably to their cost and consequent depreciation.

Coming back to the fuel item, let us look into the efficiency of the rotary as a heating machine. Many tests have been made on the 60-ft. kiln (burning cement) to determine the heat losses. While the modern kiln is considerably longer and somewhat more efficient, still the following figures will afford an idea of the magnitude and relative importance of present-day losses. Eckel gives

Heat[2]	Per cent
Supplied	100
Utilized	24
Lost in clinker..	13
Lost in stack gases..	53
Lost in radiation..	8
Unaccounted for	2

We have seen that the early workers on this kiln recognized the great waste of heat in the hot clinker and stack gases. Instead of using a long kiln (which at that time was not easily constructed) to save this heat, they attached mechanical arrangements to a short one. These did not prove very successful. The Americans had better success with a longer kiln and as their early plants were located where fuel was cheap, they put up with the inefficiency and devoted themselves to enlarging their plants and making money. Within the past few years the price of coal has advanced and we now find the cement men spending huge sums for the recovery of heat previously wasted. They generally install waste-heat boilers in the path of the stack gases. Jones in his early work on lime installed such boilers, which were successful, although not easily cleaned. A good installation of this kind will furnish all the power necessary to run the plant. To secure satisfactory results such installations must be carefully designed as to draft and disposition of dust carried over from the kiln. The heat carried out by the hot lime is easily recovered in a 40-ft. cooler if it is in granular size, but longer coolers should be used for the larger lime sizes.

Influence of Size on Fuel Consumption

This brings up the matter of the influence of stone size on the fuel consumption of the kiln. Lime is a poor conductor of heat, while limestone is a good conductor.

[2] E. C. Eckel, "Cements, Limes and Plasters," page 497. Wiley & Son, 1905.

It follows that when the surface of a stone has become coated with lime, the temperature of the surrounding gases must be greatly increased in order to drive the heat into the center of the stone and calcine that center in a reasonable time. This is why kiln temperatures are always higher than those given in the books as necessary. The larger piece may not require more heat units for burning than the same weight of fine material, but the higher temperature necessary means increased heat losses in the stack gases and by radiation. A reduction in stone size from 3/4 in. and less to 1/8 in. and less gave a reduction in fuel of approximately 10 per cent in a plant operated by the writer and showed conclusively that where coal is high in price the added expense of fine crushing is more than overcome by the lower fuel cost due to fine raw material. Experiments on cement also show that increased fineness tends to reduce fuel consumption.[8]

The gasification of fuel in a gas producer always incurs loss of heating value, which may be aggravated by long and exposed gas flues, which must always be as short as possible and covered with heat insulation to secure the best results.

Maintenance and Repairs

Maintenance and repairs are naturally higher in a mechanical plant, either vertical shaft or rotary, where there are motors, conveyors, crushers, and elevators to be kept up in good working condition. This means that an intelligent group of workers must be had, or at least a good mechanic, to keep the machinery oiled and adjusted. A large repair item in plants using a high heat in the kilns is the frequent relining of the firebrick in the lower end of the kiln. This also cuts the annual output of lime seriously. It can be avoided by the use of fine raw material, thus allowing a lower burning temperature.

Use of Various Fuels

The kiln can be adapted to use any fuel which can be burned in sufficient volume just inside the hood. This includes oil, natural or producer gases and powdered solid fuels. The first kilns were operated with crude oil, but its variable and generally high price led to the development of powdered coal, which is practically always now used in cement installations.

Both oil and powdered coal give excellent results in modern burners. Fuel oil makes a first-class lime, which cannot be said of powdered coal. It is likely that operators producing common lime will find, however, that its use is not objectionable, provided a coal low in ash and iron is used. Manufacturers of finishing lime and hydrate generally use producer gas, although this fuel leaves something to be desired. The producer should be mechanically operated so as to secure an even supply of gas throughout the day, as the gas is weak and variations affect the output of lime seriously. If the plant has two kilns, it might be advisable to use three producers, so as to secure this desirable feature to a greater extent than would be possible with two. Again, the gas is not handled advantageously.

Producer gas, although lighter than the combustion air coming from the cooler, is generally introduced above the air, whereas it should be introduced below, in order to secure quick mixing and rapid combustion. Because the kiln is in one sense an open flue, we must secure combustion and secure our heat in the kiln as early as possible. As it is, the gas and the air flow along together, CO_2 from the stone becomes mixed with the air next to it, and the result is that temperatures become lower. The gas goes out the stack unburned, as is evidenced by smoke and an analysis of the stack gases. If the kiln man reduces his draft to allow the gases to burn, he may not draw enough air to keep up his heats, and if he increases his draft, he introduces excess air with its attendant losses. So he generally restrains the draft just enough to maintain the heats and lets the losses take care of themselves. Some kilns have been provided with a gate at the outlet of the cooler to control the draft, but there are so many places where air can be drawn in that this gate has been useless. Cold air should be kept out of the kiln by making and keeping the joints of the kiln at the hood and dust chamber as close as possible.

Proper Stone Sizes

The influence of the raw material on the rotary kiln is very marked. If it were not for the high quality of much of the soft, crumbly limestones that could not be calcined easily in the vertical shaft kiln, it is doubtful whether there would be many rotary kilns operating on lime today. Its success on such material has pushed it into prominence, so that now it is advocated for any kind of raw material. It is naturally a fine material kiln, just as the vertical shaft is naturally a coarse material kiln. It was developed on such material (cement) and on such does its best work.

As proper sizing for the kiln is a matter of some importance, a little study of the subject may be worth while. Since a large lump of limestone will roll through a rotary kiln faster than a small one, the sizes of the stone fed to the kiln should be as nearly uniform in size as possible so that all lumps get the same time exposure to the heat. With a long kiln, lime from an easily burned dolomite can be calcined up to 1 3/4-in. size, provided the stone is evenly sized. Where there is extreme variation in size the fine material will be overdone and the coarse underdone. We must decide then from the nature of the stone whether it is more economical to use a large size and reject the fines, or crush down to small size and retain them. We all know that the larger the lump of stone in a kiln, the higher the temperature or the longer the time the stone must be heated, due to the poor heat conductivity of the newly formed lime on its surface. Now, in a rotary kiln, the time cannot be lengthened much as the kiln is constantly revolving. So with the larger sizes of stone we must use the higher temperature, notwithstanding the additional heat losses and repairs. Experience indicates also that the output is less on the larger sizes. It should be pointed out, however, that there may be cases where the additional cost of fine crushing will more than equal the saving of fuel and repairs. An interesting case is that at Adams, Mass., where a crystalline marble of uniform softness is burned in mixed sizes with no rejection of fines. The stone is so tender that lumps up to 2-in. sizes automatically break up into their crystals in passing through the kiln. Here the fine crushing is done by the kiln itself, but at the expense of temperature, which has to be very high in order to calcine grains released late in the kiln. The lime is granular. Determination of sizing should be passed on by a competent engineer in every case as it is a matter of great importance.

Dust Variations in Plants

Plants vary in the amount of dust encountered in the process. Sizing has some influence on it as the sedimentary limestones seem to produce more dust than the crystalline. It is also possible that more dust is ground off larger sizes than the smaller, due to the greater weight of the individual pieces.

Influence of Stone Sizes

As we have seen the influence of the stone size on the kiln, let us now look into the rotary's influence on the stone. This is possibly covered by the statement that the kiln can handle all grades of stone with equal ease—high magnesium or high calcium, hard or soft. This is not saying that it will handle all grades at equal cost. As in the shaft kiln, the magnesium stones will require less temperature and less fuel. Also, some soft stones can be reduced to kiln size cheaper than hard ones. Quarry spalls, if clean and of good quality, can be reduced and calcined as cheaply as the larger lumps, thus turning a waste into a profit.

Makes Good Lime

The rotary kiln makes good lime. When first introduced, doubt was expressed as to whether the fine lime would sell easily, as buyers might think it to be ground lime, or worse, air slaked. It was soon found that, when carefully burned, it was very quick in slaking and, if anything, more plastic than lump lime burned from the same stone. When burned in uniform sizes it can be calcined lightly or dead-burned very uniformly at will, as all of the material is subjected without question to the same heat-

[8] Spackman. Rock Products, July, 1904.

ing. This statement cannot be made about any vertical shaft kiln.

It has been found advantageous in some of the uses of lime to mix it dry with other limes before slaking, or with other materials, as in sand-lime brick manufacture. Sometimes it must be in small sizes for use in the process employed, such as hydrating. In all these cases the rotary product can be used without any preliminary grinding. This gives it a higher selling value when marketed for such uses. Or, it can be hydrated where burned at less cost. These facts should be considered when estimating the profits of rotary operation as contrasted with shaft kiln operation.

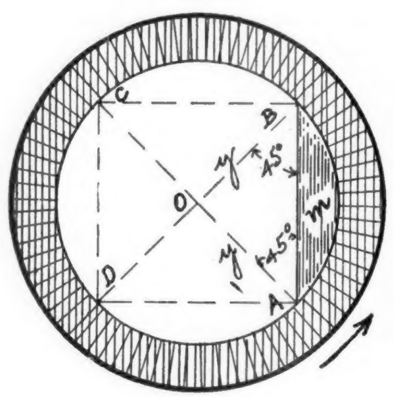
Instrumental Control

Proper control of operation and of costs demands a means to register the fuel consumption and lime output daily in order to remedy any cause of reduced output or high fuel consumption before large losses accrue. Such measurements also furnish a rough guide to the relative value of the fuels used when changes are made in them. There are many automatic devices for coal weighing, and the one used should be adapted to local conditions. The same may be said regarding the lime measurements. As the installation is under dusty and gritty conditions, a rough-and-ready device is to be preferred over highly accurate balances, whose accuracy is unnecessary. Where the lime is in 1-in. sizes and over, a recording tachometer or speed register attached to the kiln will probably do if the kiln load is kept constant by an automatic feeder. In this case the output per day is a direct function of the total revolutions of the kiln for that day. By test we can determine the lime delivered per revolution and from this get any day's output.

It will be noted by the experienced lime manufacturer that the process outlined affords no opportunity for sorting the lime. It is true that a careless operator may allow clinker and core to pass along through the cooler and become mixed with the good lime in the lime tank. Being human, the kiln man will not always be careful unless checked up. This difficulty was overcome by the writer by using a form of automatic sampler, which takes samples every 20 min. and preserves them separate under lock and key for the later inspection of the superintendent. If a record is kept by the kiln man of the times he was rejecting poor lime, this record can be checked against the samples taken, thus indicating whether all the poor lime was properly disposed of. Thus this ever watchful device compels vigilance and secures quality of product. An automatic sampler is also necessary where lime is sold on an analysis to the chemical trades. By its use an analysis can be made of an average sample as often as desirable and a record kept. Thus lime can be sold on a guaranteed analysis if so desired; lump lime can also be sampled.

Use of Pyrometer

Usually the kiln man judges his heats by color, making his observation through a peek-hole in the hood. Such methods are becoming obsolete as the unaided eye is a very poor thermometer. Again, some men are color blind; besides, the light in every case impresses the eye differently at different times, depending on the condition of the pupil, which automatically opens and shuts to regulate the amount of light entering the eye. This means that the eye must be given time for anything like accuracy. But the kiln man cannot wait and so makes his speed adjustments with more or less snap judgment. How much better to use a recording pyrometer, where the temperature is shown accurately! Should a gas producer be employed, this instrument will also prove of value as it will not only guard against carelessness of the producer man in allowing his machine to get too hot, but also



Finding the kiln size needed

indicate the times when he charges fuel. In this case the pyrometer couple should be placed in the gas outlet from the producer or as near to it as possible.

After the possibilities of these instruments have been worked out, the Orsat apparatus for measurement of stack and other gases, should be added as its use in checking up burning conditions to detect poor combustion, excess air, etc., will prove valuable.

Manufacturers as a rule are not awake to the possibilities of instruments for control. Not understanding their use they apparently think that they can be handled only by experts. Most of the instruments are simple, easily handled, reliable, and money-savers.

Correct Size of Kiln

In designing a kiln or selecting the correct size for certain conditions, perhaps the first question will be: What is the best diameter to use? In the first place, the output is roughly a function of the kiln diameter, as can be shown mathematically as follows: Referring to the diagram, let the inner circle about O represent the inside line of the firebrick of the kiln, which is supposed to be revolving in the direction of the arrow. The raw material is carried up by the kiln on the right side and falls back at the angle of repose, which is approximately 45 deg. to the horizontal.

Draw OA vertical and OB horizontal through the center O. Draw AB for the slope of the material. Let the area m represent the cross-section of the kiln load. This area then will vary directly with the kiln load and hence with its output. We will show that this area is a function of the diameter and varies directly as its square.

(1) Area m = area of circle less area of square $ABCD \div 4$.
(2) Area of circle $= \pi \times 2y \times \frac{1}{2}y = \pi y^2$.
(3) Area of square $= \sqrt{y^2+y^2} \times \sqrt{y^2+y^2} = 2y^2$.

Substituting in (1)

$$\text{Area } m = \pi y^2 - 2y^2 \div 4 = \frac{\pi - 2}{4}(y^2)$$

But $y = \frac{1}{2}$ diameter

$$\text{Then area } m = \frac{\pi - 2}{4}\left(\frac{\text{diam.}}{2}\right)^2$$

Thus we would expect under similar conditions and length of kiln that the output of a rotary would vary as the square of the kiln diameter, taking as that diameter the inside of the lining measurement. As an example: If a kiln having a diameter of 6 ft. turns out 30 tons of lime per day, what output would we expect to get with an 8-ft. kiln of the same length on the same stone? As the linings are 9 in. thick, the working diameters are 54 and 78 in. respectively.

54 squared = 2916.

78 squared = 6084, which is a little over twice 2916.

This would lead us to expect double the output, or 60 tons, from the 8-ft. kiln. This is confirmed by actual results. In the second place, the kiln must be mechanically strong and large enough to allow easy inspection of the lining and repair throughout its length. This precludes sizes under 6 ft.

Having decided tentatively on the diameter, let us next consider the length. For mechanical reasons this is limited by the diameter. A small diameter does not afford the required stiffness to the longer kilns when running on two bearings. This can be overcome by using two cylinders in tandem, separately driven. This is not as simple or as easily handled, although sometimes adopted, not for the object of using small diameters, but in order to get the higher heat efficiency of the long kiln. Theoretically, the best proposition from a heating standpoint would be a kiln so long that the waste gases were just hot enough to produce the required draft in a tall chimney. This kiln would be lagged to prevent heat loss from radiation.

Practically, we have to balance the cost of the heat losses in a particular layout against the cost of eliminating them and

content ourselves with the best design possible after such a study. As the mechanical and financial considerations become heavy in very long kiln layouts, designers are using short kilns and conserving the waste heat by installing waste heat boilers. Preheaters can also be used, and should be on very short kilns; otherwise, the flame temperatures must be run very high. Final determination of kiln length and diameter should be decided by an experienced engineer after careful study of local conditions.

Slope and Speed

What slope and speed shall we give the revolving kiln? These functions determine the length of time that the stone is under heating. If we have an easy-burning, magnesia stone, small in size, we can push it through the kiln faster than if we were using a hard-burning, high-calcium, small-sized stone. Consequently, in the first case, we can pitch our kiln steeper, run it faster, or both. As the kiln is heavy and often long, we ought not to run it very fast on account of the mechanical jar and racking of the joints, besides the increased power required. The speed, then, we will limit to about 1 r.p.m., and for the easier burning material use a larger slope, say, 4½ or 5 per cent instead of 4 per cent.

We must next provide for variation of the kiln speed so that the kiln man can control the movement of the stone through the kiln as his judgment dictates. If the stone runs uniform in size and quality, and the heat is steady, little or no adjustment of speed is necessary after the heats are up. Generally, the heat does not run uniform, and the stone from some quarries runs uneven, so that constant care is needed in handling the kiln.

The graph shows a case where speed readings were taken every 15 min. There are very few observations shown where the speed was the same as 15 min. before. The necessity of constant care by the kiln man is evident from this diagram. The kiln is generally run by a variable speed motor and geared to move at any speed from about ⅕ to 1 r.p.m.

Some Prominent Defects

From this discussion we have found that when fired with producer gas, the rotary kiln has the following prominent defects:

1. Poor combustion, with excessive stack gases.
2. Stack gases at a high temperature.
3. High radiation losses.

These items account for the low ratio of lime to coal or the relatively high fuel consumption. It will be noted that all have to do with kiln heat efficiency. It can be said that progress for the reduction of these losses is being pressed at the present time of high fuel costs, and soon we can expect much better economy by the use of kilns having heat-conserving devices. In an endeavor to assist in this good work, we will mention a few suggestions that have been advanced to improve rotary efficiency. So far as the writer knows, none of these ideas have been tried out.

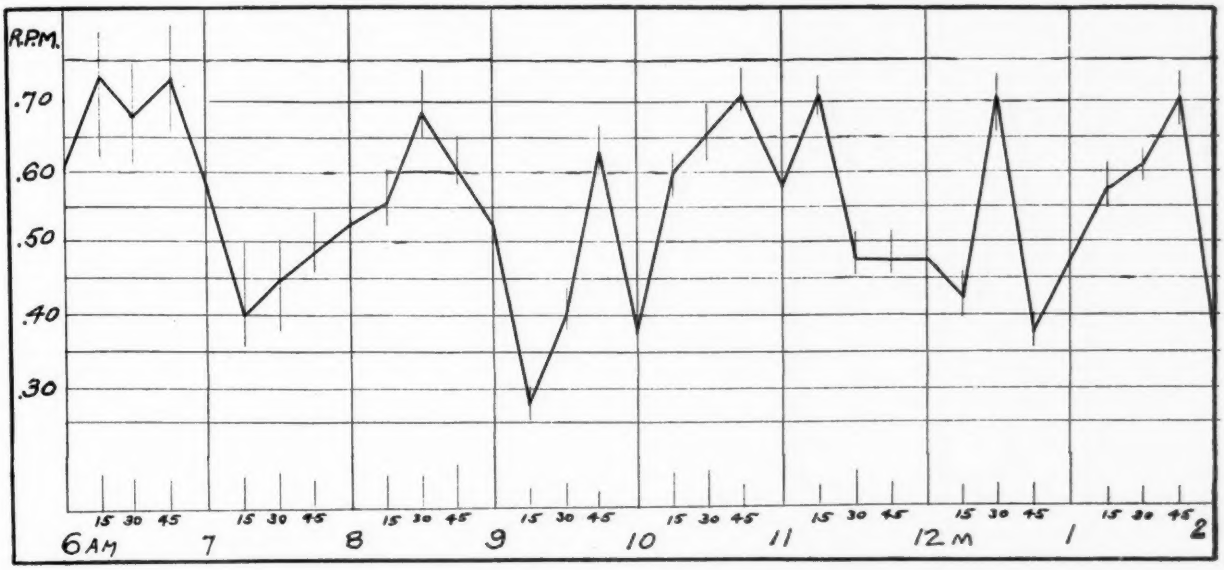
For Rotary Efficiency

The poor combustion conditions with producer gas have been noted. It is suggested that the gas should be mixed with part of the air for combustion before entering the combustion space in the kiln, thus duplicating the well-known bunsen burner principle. The length of flame could be readily controlled by admission of more or less secondary air to such a stage that a minimum of waste gases are thrown away. This experiment could be made for a modest expense, especially in a new installation.

Another proposition to improve combustion, and also reduce radiation losses, is the use of two cylinders placed in tandem, the lower burning cylinder to be covered with a jacket, through which secondary air heated by radiation is drawn through the joint between the two cylinders. This air burns up the gas which is about to escape from the kiln unburned. If the trial of this experiment is unsuccessful, still the kiln could be operated on current lines with economy due to its length.

High stack temperatures are being attacked by the use of waste heat boilers, as has been noted. Where additional power is not needed, or is very cheap, we can use, instead of boilers, preheaters for the stone. These may be rotary or Scott kiln type. The use of these devices can hardly be called experimental, as they always save heat if properly designed and installed.

Where the stone is of crystalline formation and very tender when heated, there has been proposed a combination of vertical and rotary kilns. Between the two is a revolving disintegrator. The vertical kiln acts as a preheater and takes man-size stone. At the bottom of the vertical shaft a feeder forces the red-hot and tender stone into the disintegrator, which reduces it to its crystals and delivers it red hot to the rotary. The rotary completes the burning easily in the usual way. We here have the vertical and the rotary working under conditions best suited to each with very easy and cheap reduction of stone size. This experiment would incur some expense if a failure, as we would have to build a dust chamber to take the place of the disintegrator and put a boiler in the vertical shaft in order to save our kiln.



Kiln speed varied constantly and rapidly, as this curve of actual readings shows

Losses from radiation can be reduced by generous lagging on the producer flues and the use of some non-combustible, heat-insulating material, like asbestos, mineral wool, etc., between the firebrick and the shell of the kiln.

Conclusion

We find the rotary kiln to have the following distinct advantages:

1. Can use stone from any quarry.
2. Can use all the chemically good stone.
3. Gives a superior lime due to uniform heating.
4. Stone, lime and fuel easily handled, mechanically.

It is the only modern kiln which will successfully calcine quarry spalls or the soft limestones. There is a large amount of soft stone of excellent quality which could not heretofore be marketed, not because it was inaccessible, but because it could not be calcined except in the pot kiln or the Hoffman ring kiln. These kilns are both expensive to operate in this country; the first on account of heat losses and the latter because of high labor costs. When the inefficiency mentioned has been corrected, the cost of lime as calcined in the rotary will be reduced so much that it will possibly become the leading form of kiln for lime, especially as it can produce a better quality than the vertical shaft kiln. It does not lend itself, however, to the needs of the small manufacturer, as outputs under 30 tons per day are impractical and the high initial cost prohibitive.

[4] Truesdell and Phillips patent, No. 1350750, August 24, 1920.

Potash Producers Ask United States Aid

AMERICAN potash producers on March 19 petitioned President Harding and Congress for relief from "cut-throat" German competition which, they assert, means ruin for American business and German domination of the sale of potash in the United States. Forty-three producers say that they do not want a subsidy to maintain their industry, but protection from the dumping of the German product at prices designed to undersell home producers for the sole purpose of gaining control of the market. The petition imputes a German government plot and submits charges as abstracted:

1. The German government, through its official agencies, the Deutches Kali Syndikat, has destroyed property opened by American citizens to the extent of about $30,000,000 during the last year.

2. This destruction was performed deliberately with the intent to stamp out American competition with the German potash monopoly.

3. German agents threatened and predicted this action just before the United States declared war on Germany in 1917, in an endeavor to frighten American citizens from investing their money in this industry.

4. While the United States was engaged in the world war, the German government and the German potash monopoly were preparing for this destruction of American property after the war and compelled more than 10,000 allied prisoners to assist in the preparations.

5. German agents are now conducting an extensive propaganda in this country to mislead Congress and the public about the needs of the American potash industry to the end that it may be denied the protection it seeks from foreign aggression and may never be revived.

It is charged that the Germans in September, 1921, contracting with 34 American concerns dealing in potash as middlemen and fertilizers manufacturers to purchase a minimum of 75 per cent of their requirements. The first plan of the Germans to give them an unusually low price on the condition that they take their full supply from Germany was abandoned because it might have run counter to the American anti-trust laws.

"Whether or not the terms of the contract with the French syndicate were dictated by the directing minds in Berlin," says the petition of the American Producers, "the similarity of the contracts in every particular of the strongest evidence of that."

Illinois Concrete Aggregate Association Holds Live Meeting

LOWER insurance rates, a new method of determining dues, progress on the new accounting manual and the beginning of work to improve the operation of the mechanic's lien law were some of the important things about which producers at the Illinois Concrete Aggregate Association meeting in Springfield, March 16, heard.

J. D. Pierce, whose term as secretary was to expire on April 1, was re-engaged for one year, the engagement to continue from year to year until one party or the other gives 60 days' notice. This arrangement was made to obviate the necessity of the special meeting each year for the purpose of re-electing a secretary.

President B. H. Atwood in his report touched rather fully on freight rate conditions. Secretary Pierce in his report told of trips to all parts of the state and of addresses he had given by invitation before the Milwaukee and the Wisconsin Associations. He reported better co-operation which the association is receiving, especially in the effort to improve the operation of the mechanic's lien law. A study is being made of this law with the purpose of securing more satisfactory operation of the law or a change in it.

The new manual, which is a complete treatise on accounting in the sand and gravel industry, is being put into type and soon will be ready for distribution.

The secretary announced also that arrangements have been made so that the base rate on compensation insurance has been reduced from $4.08 to $3.50. The same debit and credit allowances and the same experience rating will apply on the new base rate as on the old and the new rate has been extended to include dredging and pumping operations as well as quarrying operations.

Thomas McGrath, of the McGrath Sand and Gravel Co., gave a detailed report on the accounting manual, and T. E. McGrath of the same company reported for the lien law committee.

The old method of basing dues upon the previous month's production was conceded to be unsatisfactory and the association decided to base the dues of each member on his previous year's tonnage.

At the noon luncheon Frank T. Sheets, superintendent of highways of the Illinois highway department, told some of the important problems of that department. He announced that Illinois had purchased a total of 900,000 bbl. of cement and that new bids of 3,000,000 bbl. had been called for March 24. Bids for 94 miles of road work have also been called for.

H. C. Clemmer, engineer of tests of the Illinois highway department, gave a talk. H. M. Slater, of the Illinois commerce commission, had planned to be present and talk on the effect of the recent Supreme Court decision on intrastate rates in Illinois, but he was unable to be present.

Edward K. Cormack, president of the Consolidated Co., gave an inspirational talk on co-operation. In the afternoon R. C. Yeoman, executive secretary and engineer of the Indiana Sand and Gravel Producers' Association, delivered a paper on "Grading and Measuring of Concrete Aggregates."

Some towns in Illinois have not included gravel in their specifications and the association discussed ways and means of inducing these towns to open their specifications to gravel. It was decided to start an active campaign for this purpose. The association does not desire that preference be given to gravel, but it wishes to have it placed on a par with crushed stone.

The Removal of Clay from Sand and Rock

No. 4—The Removal of Free Clay—Theoretical and Primary Principles of Washing by Filtration and the Settling Out Process

By Edmund Shaw
Allen Cone Co., El Paso, Texas

THE greater part of the clay that has to be removed in washing sand and rock is free clay—that is, it does not adhere to the surface of the grains as a tight film and it is not in the round, hard lumps which will not dissolve in water, known as "clay balls."

This free clay is soft and goes into suspension readily when stirred into water. It forms the greater part of the clay that has to be removed by washing. In most cases (washing concrete sand and the like) it is the only form of clay that is present except in the rarer deposits where there are clay layers to form clay balls. Even in the cases where we have to remove clay balls, or where there is a tightly adhering film on the surface of the grains (as with silica sands), we still have the free clay present, so what is said here is applicable to the washing of all of these substances.

Primary Principle of Washing

The whole of the theory of washing is based on the following:

The removal of the clay (or whatever substance is to be removed by washing) is in proportion to the removal of the water used in washing.

This rule applies to both kinds of washing—filtration, which is washing through the voids, as gravel is washed, and decantation, which is washing by taking off an overflow. But the water left behind in filtration is so small a proportion of the water used that filtration offers no problem. The discussion will therefore be confined to decantation, or, as it is also known, washing by the settling out process, or "bin washing," etc.

The rule just given is easy enough to understand. As an example, let us suppose we have clay and sand stirred up with 10 parts of water; that we allow the sand to settle and draw off 9 parts as an overflow, and leave 1 part with the sand. It is quite evident that by doing this we will remove 9 parts of the clay with the overflow and leave 1 part behind with the sand. In other words, we will have a 90 per cent removal of both water and clay. And the mass, or quantity washed, has nothing to do with the rule, which is as true for the chemist washing a few milligrams of precipitate as it is for the sand washer superintendent who is putting 5,000 tons a day through the plant.

Residual and Overflow Water

A part of the wash water is left behind in all washing, even though it is only enough to wet the surface of the grains. In the kind of washing we are going to consider (that in which the sand is settled out) the water left behind is much more than this, as it has not only to coat the surface of the grains but to fill the voids as well. As a convenient name, we will call this water in the voids *residual water.* And the water that is run off from above the surface of the settled sand we will call *overflow water.* The terms "overflow clay" and "residual clay" will be used for the clay that goes out with the overflow and the clay that remains behind with the sand.

In the tables that follow the word "water" will be used for water with clay in suspension. To figure it down to pure water would change the results too little to be of importance and would complicate the calculation.

Residual Water Depends on Voids

The amount of residual water with any particular sand will naturally vary with the percentage of voids in the sand since the water is contained in the voids. The percentage of voids in sand, as has been explained, varies widely, according to the grading of the sand, the shape of the grains, etc. This gives certain sands an advantage over others in washing, but the difference is less than might be supposed at first.

As an example: In the case we just used as an illustration, 90 per cent of the clay was removed by taking off 9 parts of water and leaving 1 part with the sand as residual water. Let us assume that this sand had 35 per cent of voids. Now let us assume that we use the same amount of water on sand which has only 30 per cent of voids. Instead of taking off 9 parts as an overflow, we will take off 9.14 parts. In other words, we will remove 91.4 per cent of the clay instead of 90 per cent. Admittedly, the percentage of voids makes a difference in the efficiency of the washing, but from a practical point of view the difference is so small that it does not have to be taken into account.

Amount of Water Held in Voids

To one who tries the experiment for the first time it is alway rather surprising to find out how much water can be added to sand without more than filling the voids. Take ordinary concrete sand, which may contain 35 per cent of voids weighing a little over 100 lb. to the cubic foot. If 35 per cent of this cubic foot are voids, then it is evident that the voids will contain 35 per cent of 62½ lb. of water, or 21.9 lb. Almost 22 lb. of water may be added to 100 lb. of such sand without more than filling the voids.

And this 35 per cent is a low percentage compared with what we will find in some materials. There are fine sands and sands with a fairly uniform size of grains that will have a much larger percentage. Fine sands, weighing 90 lb. to cubic foot, will contain 45 per cent of voids, and the water required to fill the voids is 31 per cent of the weight of the sand instead of 21.9 per cent, as in the concrete sand mentioned.

Effect of Specific Gravity

When we are figuring the residual water in the voids, using the weight of the sand as a base (as we have just done), we have to know the specific gravity of the sand. In the cases just mentioned it has been assumed that the specific gravity was 2.63, because building sands, concrete sands, etc., are usually particles of rocks which have that specific gravity. But if we were dealing with coal, with a specific gravity of 1.3 we should find that the same amount of water gave twice the *percentage,* using the weight of the coal as a base.

In the tables that follow it is supposed that we are dealing with material having the ordinary specific gravity of 2.63 unless some other material is mentioned.

Effect of Porosity

There is one material that must be mentioned especially in this connection. and that is phosphate rock. The actual specific gravity of phosphate rock is even higher than that of ordinary sand, but

its *apparent* specific gravity is lower, owing to its porosity. Where ordinary sand weighs 100 lb. to the cubic foot, phosphate rock (or at least the Tennessee variety) weighs only 84 lb. This lighter weight is due to the pores it contains.

As these pores will contain water when the rock is wet, we have two kinds of residual moisture to deal with—the moisture in the pores and the moisture in the voids. Experiments have shown that a piece of phosphate rock which is dry on the surface may contain 14 to 15 per cent of moisture. This is not properly residual moisture, so far as washing is concerned. We have only to take into account the moisture which is held in the voids. It has been determined that with phosphatic sands the moisture held in the voids is 46 per cent of the weight of the sands, under the conditions which usually accompany the discharge of the sand. And it is this figure which will be used in discussing the washing of phosphate rock.

Voids in Running Discharge

In No. 3 of this series (see Rock Products, March 11, 1922, page 23) it was explained that a running discharge contained a greater percentage of voids than the same sand would contain if it were simply settled in the bottom of a bin. The writer has sampled a great many sand discharges from various forms of continuous settling devices and finds that they will average 30 per cent moisture. Actually, for sand of ordinary specific gravity, the moisture contents will run from 27 to 31 per cent, and the greater number will run in the neighborhood of 31 per cent, so 30 per cent has been taken as a fair average. This means that the water will be approximately 43 per cent of the weight of the sand, so the residual moisture in the tables following is 43 per cent of the weight of the sand.

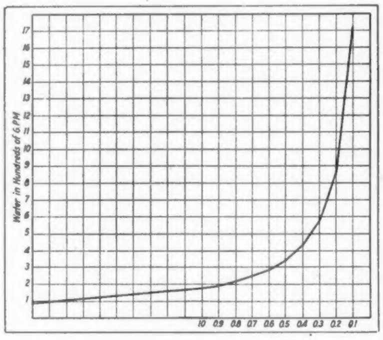
It must be remembered that washing is usually a continuous process. In the more primitive forms of washers the sand is settled in a bin or box and removed as fast as it settles by flowing it out as a quicksand through a manually controlled gate. In better forms the settling bin is replaced by an automatic form of sand tank, or cone, or one of the mechanical devices which excavate the sand from the settler as it accumulates.

Hence, whatever the form, we have usually to deal with a discharge which will contain about 30 per cent moisture, and that in round numbers means that the weight of the water is 43 per cent of the weight of the sand.

The More Water the Better Washing

Of all the factors which affect the efficiency of washing, the most important is that of *dilution,* or the proportion of water to solids, the efficiency varying with the dilution. Put in simple language, this says that the more water we use the cleaner the washed product will be. We have just seen that we can add a considerable quantity of water to the sand and only fill the voids, in which case there would be no washing whatever. Every gallon of water that we can take off as an overflow takes off its proportion of clay, so the more overflow water we can take off, the cleaner the product will be.

It is quite possible, if we know how much clay and sand are present, and how much water we are using, to figure out



The more water used in washing, the less clay remains; but it's expensive to wash too clean

by simple arithmetic how much clay will be left in the sand. Conversely, if we know how much clay we can afford to have in the sand we can figure out how much water we shall have to use to reduce the clay to that amount.

But before we pass on to that it may be well to mention that dilution is of importance in other ways than that of imparting efficiency to the washing. There is, first of all, the matter of economy. Wherever water has to be pumped to supply the washing plant, the cost of pumping is a serious item on the cost sheet. And, next, there is the recovery, for if so little water is used that it becomes thick with clay, the fine sand will not settle out.

Rule for Figuring Water Required

The best way to explain this rule is to use the method in a regular problem. Let us suppose we have 100 tons of material containing 90 per cent of sand and 10 per cent of clay which we want to wash so that the sand will contain only 1 per cent of clay. In that case the 90 tons of sand will be 99 per cent of the final washed product and 100 per cent will be 90 ÷ .99, or 90.9 tons. The 1 per cent of clay will hence be .9 ton. We want to throw away 9.1 tons of the clay in the overflow and leave .9 ton in the residual water which is in the sand voids.

We have seen that this residual water will be 43 per cent of the weight of the sand, and if the sand weighs 90 tons, the residual water must be 38.7 tons. This will contain .9 ton of clay. The overflow water to carry off 9.1 tons must be as many times 38.9 as .9 is contained in 9.1, which is 10.11+. Multiplying 37.8 by 10.11 we have 391.26 tons as the amount of *overflow* water we shall need, and adding to that the residual water of 38.7 tons we have 429.95 tons as the *total* water we must use—say, 430 tons.

But having it in this form does not give us a practical working figure for pumping and the like. We want it in gallons per minute. We will suppose we are going to wash this 90 tons of sand in a 10-hour day, or 600 min. We have 430 tons in 600 min. or .717 ton per min. This .717 ton is 172 gal. per min., if you use short tons, and 192.6 if you use long tons. Putting it on the basis of 100 tons instead of 90, we have 191 and 214 g.p.m. for short and long tons respectively. In round numbers, we want 2 gal. per minute to wash one ton of sand per day, reducing the clay to 1 per cent if the original material contains 10 per cent of clay.

Putting this in the form of an arithmetical rule, we have:

Divide the total weight of clay by the weight of the clay that is to be left in the sand and multiply the weight of residual water by the quotient. This will give the total water required.

To shorten the work of calculation, since we want our results to be on the basis of 100 tons, we may use the weight of residual water in 100 tons, which is 43 tons, in the place of the 38.7 tons, which was used in making the explanation. And this has been done in making Table I, which has been made according to the rule just given. The total water has been reduced to gallons per minute for 100 tons per day of 10 hours and put into the column farthest to the right.

The Washing Curve

This last column has been put in the form of the curve which is shown above. It is interesting to see the effect of adding water to the overflow. We start with 86 g.p.m. and leave 2 per cent clay in the sand. We double the quantity of water and bring the residual clay to 1 per cent, which is taking it out pretty fast. Then the curve begins to turn upward, showing that we have to add more and more water to take out the clay. At the last we have to double the amount of water, from 860 g.p.m. to 1720 g.p.m., in order to reduce the clay content of the sand from 0.2 to 0.1 per cent. Obviously, the use of so much water would not be economical. If we want *very* low clay contents, we must get them by rewashing, or rinsing, as will be explained in a later article. It is apparent that the most economical use of water—that which gets out the most clay for the least water pumped—lies somewhere on the curve before it begins to approach the vertical.

To reduce the clay to less than 0.1 per

cent we should have to use very large amounts of water, doubling the amount each time we cut the clay content in half, and this means that to get all the clay out of the sand we should have to use an infinite amount of water. Washing to zero clay content in one wash is theoretically impossible.

Application to High Clay Materials

The rule and the table have been applied to material which has 10 per cent of clay, but it may just as well be applied to material having any amount of clay. Let us take the case of phosphatic sands carrying 50 per cent of clay. To reduce these to a clay content of 1 per cent or less would require so much water as to be impractical if the water were used in one wash. For the first wash we will be content with a 3 per cent residual clay. On a basis of 100 tons, we will have 100 tons of clay since we are dealing with a "fifty-fifty" mixture. Dividing 100 by 3 we have 33.3 as the required quotient, and multiplying this by 46 (the residual water in phosphate rock is 46 per cent) we have 1531.8 tons as the total water required. But this would be a mixture with more than 6 per cent of clay and the settling of the fine sands would be slow.

In washing material with a high clay content, this is the point which must always be kept in mind: The water used must be sufficient so that the settling rate of the sand is not too much affected by the clay in the water. And when enough water is used to assure a good settling rate of the fines the residual clay content is fairly certain to be satisfactory.

Effect of Different Percentages of Clay

We have considered the water required to reduce material with a constant clay content to varying amounts of residual clay. In order to apply the principles of washing thoroughly we must next consider material having varying amounts of clay to find the extra water required for each variation.

Table II has been prepared showing the amount of water required for each per cent of clay in the crude material, from 5 to 20 per cent, washing the sand to 1 per cent of residual clay. It is figured on the basis of 100 tons of washed material per day. Since the residual clay is in all cases 1 per cent, the quotients, which are used to multiply by residual water, are in all cases the same as the percentage of clay present.

A curve has also been made of the gallons per minute required, and this is given directly below. The most noticeable thing about this curve is that it is a straight line. This is because the amount of water used varies *directly* with the amount of clay present, as we suppose would be the case.

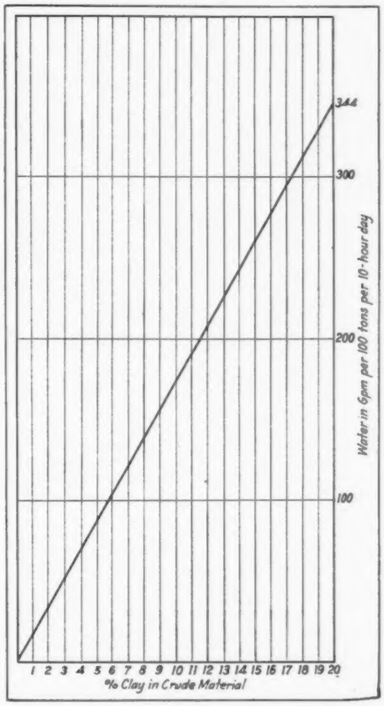
Practical Use of Tables and Curves

Let us take an example to see how practical application is to be made.

We will take a sand and gravel deposit which sampling shows to contain 10 per cent of clay. It also shows that the washed material is 70 per cent gravel (coarser than ¼ in.) and 30 per cent sand (finer than ¼ in.). We want to wash this so that the sand will contain 1 per cent of clay.

We must first take out the gravel as that will be washed on the screen. All the clay will be with the sand and all the water will also be available to remove the clay from the sand, neglecting for the moment the water that will be carried off with the gravel as surface moisture.

To get at the proportions of sand and clay we will first have to bring the per-



In washing to 1 per cent of residual clay, the water needed varies directly with the original amount of clay present

centages to the same base, and we will take as 100 per cent the weight of the crude material. This will contain:

	Per cent
Clay	10
Gravel (70 per cent of 90 per cent)	63
Sand (30 per cent of 90 per cent)	27
Total	100

We have 37 parts in 100 of sand and clay and the 10 parts of clay are almost exactly 27 per cent of the mixture. This is a higher percentage of clay than has been figured in the tables, but we can easily find the water required to wash the sand to 1 per cent residual clay by the rule given. Our quotient will be $27 \div 1$, or 27, and as we have 27 tons to deal with instead of 100, the residual water will be $27 \div .43$, or 11.61 tons. Multiplying this by 27, the quotient found, we have 313.5 tons as the water required to wash 100 tons of original material. This figures to 125.4 g.p.m. for a 10-hr. day.

If we want the water for a yard we multiply by 1 1-3 and divide by 100 and have 1.7 g.p.m. of water per yard per day. We must add a little to this to allow for the moisture taken off by the gravel (and also because we have taken clay plus water as water) and this will bring us to 2 g.p.m. per yard per day.

We might have figured it in an easier way by using the figures in Table II. If the last column is studied, it will be noticed that the figures of gallon per minute for 100 tons vary by 17.2—that is, for each per cent of clay in 100 tons we must add 17.2 tons of water. Now we have 27 tons of sand and it contains 27 per cent of clay, so we multiply $0.27 \times 27 \div 17.2$ and obtain the answer of 125.4 g.p.m. as in the first instance. The reduction to yards is made in the same way.

Neglect of the simple principles of washing is what causes trouble with the washing plant. About the commonest case to illustrate this is the conditions which occur when material with a high clay content is sent to the plant. The material contains a less percentage of the sand or rock to be recovered, so an effort is made to increase the production by crowding it through, regardless of the fact that the water available is not increased and cannot be increased. The consequence is a production of dirty material as a knowledge of these principles would show must be the case.

Following are the two tables:

TABLE I

Showing water required for 100 tons washed material produced to reduce the clay content to percentages in first column, from 10 percent

Residual clay, per cent	Quotient	Residual water (100 tons)	Total water	G.p.m. for 100 tons per 10-hr. day
0.1	100.0	43	4300	1720
0.2	50.0	43	2150	860
0.3	33.3	43	1433	573
0.4	25.0	43	1075	430
0.5	20.0	43	860	344
0.6	16.6	43	717	284
0.7	14.3	43	614	246
0.8	12.5	43	538	215
0.9	11.1	43	477	191
1.0	10.0	43	430	172
2.0	5.0	43	215	86

TABLE II

Water required for 100 tons washed sand with 1 per cent residual clay, produced from crude material having clay contents in first column

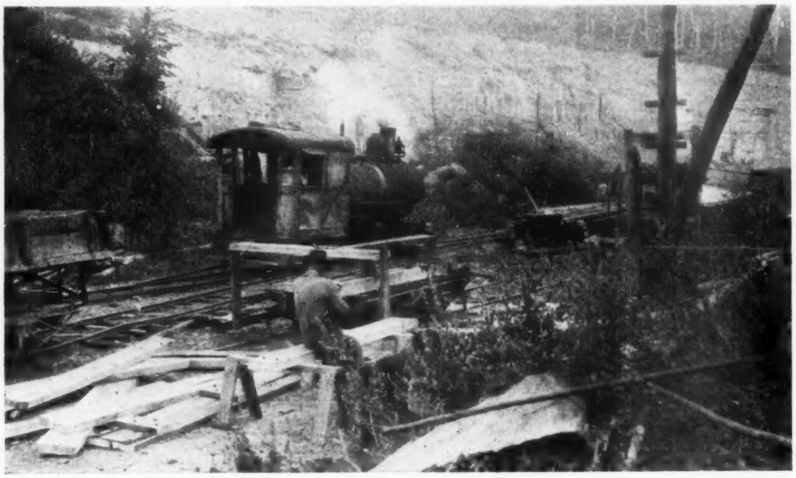
Per cent clay in crude	Per cent residual clay	Tons residual water	Quotient	Total water	G.p.m. for 100 tons per 10-hr. day
5	1	43	5	215	86.0
6	1	43	6	258	103.2
7	1	43	7	301	120.4
8	1	43	8	344	137.6
9	1	43	9	387	154.8
10	1	43	10	430	172.0
11	1	43	11	473	189.2
12	1	43	12	516	206.4
13	1	43	13	559	223.6
14	1	43	14	602	240.8
15	1	43	15	645	258.0
16	1	43	16	688	275.2
17	1	43	17	731	292.4
18	1	43	18	774	309.6
19	1	43	19	817	326.8
20	1	43	20	860	344.0

Hints and Helps for Superintendents

Using Stripping!

MAYBE in most cases stripping a quarry or gravel pit does not include the removal of trees, but where it does these may often be utilized to advantage at home.

The Norton Lime & Stone Co., Cobleskill, N. Y., does all of its car repairing with good oak lumber made on the ground. A small saw mill, already described in a previous issue of ROCK PRODUCTS, is a part of the plant.



Showing how one lime and stone company secures its lumber for car repairs

Fast Stripping on Phosphate

THE Hall Construction Co., Macon, Ga., has recently been making some interesting records on a phosphate stripping job in Florida. This company is well known in the phosphate mining district of Florida, where it has several shovel outfits at work.

The job was for the Phosphate Mining Co. at Phosmico, Fla. Last August the Hall Co. were stripping the Phosmico job with a 70-ton railroad-type shovel, equipped with a 3-yd. dipper. The digging was in sand averaging 18 ft. in depth and no blasting was necessary. The outfit was working an 11-hour shift. During August the shovel removed 67,112 cu. yd. of overburden, working 26 shifts during the month. The company states that this is the greatest amount of yardage it ever handled in a single month.

In handling this output two trains of eight 12-yd. cars each were used. These were hauled by 55-ton standard locomotives, with another locomotive of the same size to push the trains out of the pit. There was a passing track in the pit, and only about 2 min. were required to change trains. It very seldom happened that the empty train was not on the pass track at the time the loaded train was ready to pull out. The average time for loading an eight-car train was 20 min. The average haul was about 4,000 ft. Leading out of the pit the track ran up a 3 per cent grade, but this presented no difficulties. For a short distance the track ran up a 3 per cent grade at the dump also, but it was possible to get a good running start here so the grade was made without any delay.

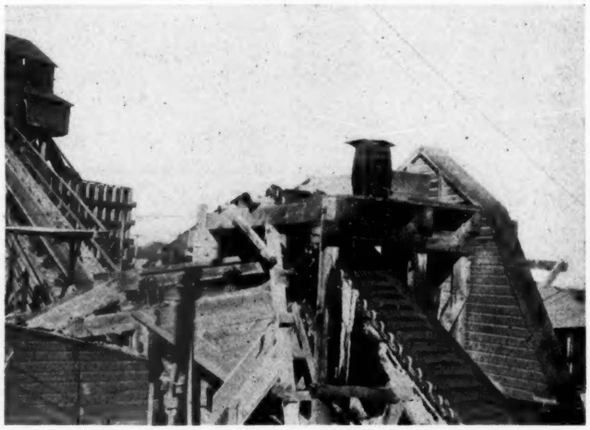
The average length of the cut was 1,600 ft. and the shovel was cut back twice. There were practically no delays during the month.

The crew who made this record consisted of the following hustlers: J. F. Hickey, shovel engineer; B. E. Lewis, craneman; A. F. Fitch, fireman; N. O. Parrish, superintendent; W. B. Hardie, dump foreman; and W. A. Colley, track foreman.

Method of Lubricating Rollers on a Pan Conveyor

AT the plant of the Flint Crushed Gravel Co., near Des Moines, Iowa, there is an interesting and practical installation of lubricating rollers on a pan conveyor. The material is deposited through a track hopper and by means of a feeder is deposited on a pan conveyor, shown in the accompanying illustration.

The rollers are lubricated in the following manner: The oil reservoir is in a barrel located on a platform immediately above the pan conveyor and the pipe. This pipe, which branches off in Y-shape, reaches out to each run of the conveyor. It has three valves, one admitting the oil from the reservoir into the Y. Each leg of the Y has a petcock which allows the oil to drop constantly on each run of the pan conveyor, thus keeping it lubricated all the time. This method may well be called gravity lubrication. It is very simple and efficient.



Pan conveyor from hopper discharging into the initial shaking screen

The pan conveyor is subject to unusually severe conditions as in nearly all cases it carries a tremendous overload and sand and grit is bound to get in the bearings, thus decreasing the life of the

conveyor to a great extent. Such conditions demand a ready means of lubrication, and this company says that the method it has adopted has met all the conditions required of it at all times.

Starting Gas Engines in Cold Weather

By Charles Labbe, Johnnie, Nev.

GAS ENGINES left outside in cold weather are not easy to start on cold mornings and much time and temper can be lost if all the details are not attended to.

The way which has never failed me is the following: Drain the water off the cylinder jacket every evening, and in the morning heat a few gallons of water to pour on the cylinder (hot, but not boiling, because boiling water poured in the hopper causes sudden expansion and may crack the jacket).

Next take the sparker or spark plug out and heat the points in an open fire to a very good heat—usually hot aplenty when a drop of oil dropped on the points will smoke. Care should be taken to protect the springs or porcelain from direct contact with fire. Now pour the hot water in the cylinder hopper; wrap a rag or rope around the air intake pipe. Pour some hot water on it, bolt the sparker in its proper place, turn on the fuel, crank the engine—and it will start very easily.

The hot water in the jacket loosens the oil, makes the engine easier to turn over and gives heat to the compressed gas. No fuel will settle on the hot igniter. The warm air intake pipe heats the air which helps the gasoline to vaporize.

Sometimes the spark is blamed. The spark for a "make-and-break" must be a reddish purple flaming spark; a yellow or white spark will not ignite a compressed gas mixture. I never saw a successful multi-pointed spark plug; it splits a good spark into several weak ones that are unreliable. Have only one spark as red as possible, but no thin blue spark. The red is obtained by regulating the screw on the coil buzzer.

All electrical contacts must be clean. If the engine as a whole is kept clean there is a chance to see any little detail which may be wrong.

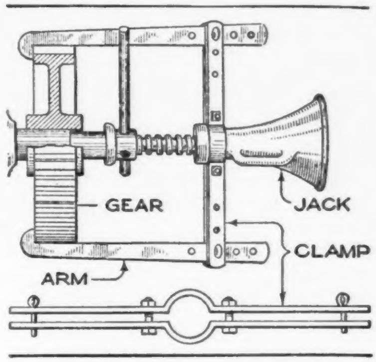
Often the circulation of the cooling water is shut off until the engine has warmed up. Do not close it entirely; leave the valve "cracked open" just enough for a little circulation. If the engine is warmed up too quickly, the steam may destroy a gasket, old breaks will open, the lubrication cannot be made properly, and bad noises will be heard—a too early spark, wrist pin knocks, piston slaps, etc., but these troubles will disappear as soon as the circulation of the cooling water is made normal.

Be sure that the piston pin is tight as a loose pin is the cause of most of the wrecks.

To keep the carbon to a minimum and the rings loose, pour into the combustion chamber a teaspoonful of kerosene a couple of times a week just after shutting down the engine. To feed kerosene while running will not help any—it makes a little more smoke. On a large engine running weeks without stopping, an oil cup can be installed to feed kerosene to the piston only at the rate of a pint an hour every day, or every other day, according to the fuel used; the regular cylinder oiling not being interrupted nor diminished.

A Screwjack Gear Puller

IN removing gears or wheels from the shafts there is a chance for doing considerable harm as many times gear pullers are not handy or they are insufficient in size for the job to be done. In such cases the man who makes the repairs, if he is careless, will usually attempt to remove the gear to the detriment of the machinery.



A home-made gear puller

Here is a shop link that will do the job properly: A screwjack and a few pieces of flat iron can be made into a powerful puller, and the worker need not hammer the gear, probably to its harm.

Around the top of the jack standard two bars are shaped to fit, drilled for clamping bolts. The bars should be made of ½x2-in. steel, not lighter. Holes drilled through each end of the crossarm take the pins which hold the pulley hooks which are drilled for the adjusting pins. As the hooks hold the gear to be removed, and with the jack head against the shaft, turning the screw will give enough pressure to pull the wheel off. These hooks should pull against the hub of the gear where it is possible.

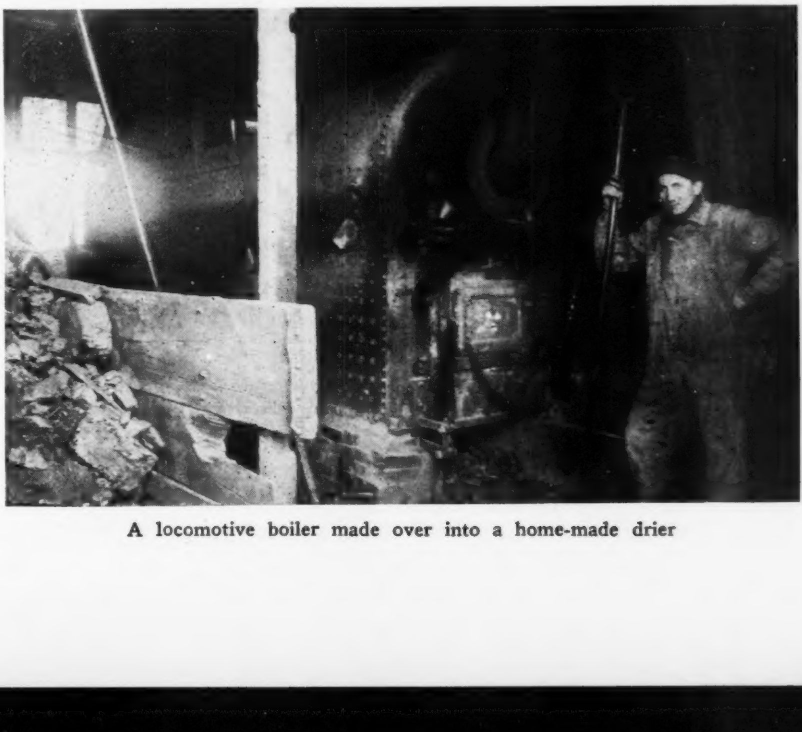
How One Home-Made Drier Worked Out

THE King's Crown Plaster Co., Cedar Rapids, Iowa, had an old locomotive boiler on its hands . A bright idea came to the plant officials that it could be made into a drier. And it was. Here is how they went about it:

The boiler flues were removed and in their stead was placed a cylinder which revolves on roller trunnions. This drier takes out the excess moisture from the sand before it is used in the manufacture of prepared plaster. The products of combustion do not come in direct contact with the sand which passes through the cylinder. Therefore, this drier is really of the direct type.

This revolving boiler has a proper pitch to discharge the sand to an elevator boot, where it is taken up by another elevator and discharged to the spout feeding a cylindrical screen.

The cylinder is driven from the same motor which drives the bucket elevator at the discharge end of the drier.



A locomotive boiler made over into a home-made drier

Sand-Lime Brick and Sand-Lime Mortar*

The Lime and the Sand-Lime Brick Industries Are Close Allies in Their Endeavor to Put Permanence in Construction

By R. P. Brown

Construction Department, National Lime Association

IT is particularly appropriate for the lime industry and the sand-lime brick industry to meet at this time on a common basis. Both industries depend for their success upon the same material—lime; both are interested in the binding power of this universal material. Lime has been used in mortar for binding brick and stone together for centuries, but it has remained for the sand-lime brick industry to use it for manufacturing the individual brick, and then in turn to bind these units together with lime mortar.

There is another joint interest between the two industries. Both are working toward the same end—namely, permanence in construction. Brick construction, whether the individual units be made of burned clay or sand and lime, is recognized as being permanent to the highest degree with respect to fire and weather. Lime mortar has the same characteristics. Neither product goes far afield from its own point of manufacture. Therefore, it is logical that the two interests co-operate to the fullest possible degree.

Some recent tests conducted on concrete brick at Columbia University have developed an interesting theory which may perhaps be applied to sand-lime brick. This theory, which seems to be borne out with concrete brick, is that the efficiency of the brick in the wall—i. e., the ratio between the compressive strength of the brick itself and the compressive strength of the pier—may be raised from the usual 20 per cent to about 75 per cent if the mortar is of such a nature as to make the pier practically a monolith.

Cohesive Strength of Cement Mortar

In this work full advantage is taken of the cohesive strength of cement mortar, for cement sticks to cement better than to any other material. With cement brick this means using a cement mortar of the same composition as that employed in making the bricks themselves.

It would seem that this theory could be applied to sand-lime brick construction and a mortar composed of sand and lime be used to good advantage, thus utilizing more nearly the full strength of the brick. In the manufacture of sand-lime brick approximately 10 per cent by weight of hydrated lime is used, or about 25 per cent by volume. This corresponds to a mortar of 1 part of lime to 3 or 4 parts of sand, which is quite customary. A series of pier tests of sand-lime brick and lime mortar would be of especial value in demonstrating the economy of such practice.

Field Conditions Not Ideal

While the tests on cement bricks laid up in the laboratory with cement-mortar indicate exceptional results, we must not forget that field conditions are not ideal, and that a mortar which is easily prepared and handled in the laboratory is sometimes impossible to obtain on the job. The strength of the wall depends largely upon how well the bricks are bedded. A brick of low crushing strength, well bedded, will develop higher wall strength than will a brick of high strength when poorly bedded.

The smoothness and easy-working qualities of lime make possible a practically perfect bed for the brick and this may be secured without the use of extra precautions or special care on the job. The bricklayer can spread the mortar more easily, and can place and shove his brick with greater facility when using lime mortar than with any other material. The lime, being smooth and free working, will fill up the irregularities of the brick, affording bearing to the entire surface, and not merely at a few points, as frequently is the case when the mortar is stiff and harsh.

The full strength of individual brick is never used in ordinary construction. The working load prescribed by building codes fixes the limit, which is far below the crushing strength of the brick, allowing an ample margin of safety in all cases. Inasmuch as there is very little available data on the strength of sand-lime brick laid up in walls of piers, we must use some data derived from tests made on a clay brick, which, from their character, may be transposed to sand-lime brick.

Two Phases of the Work

There are two phases of mortar and brick work which should be considered: First, the compressive strength of brick work laid up in various mortars; second, the adhesive strength of various mortars.

Experience has proved that a lime mortar mixed in the proportion of 1 part lime to 4 parts sand can safely carry a working load of 100 lb. per square inch. As an example of how such a mortar might be used in ordinary city construction, consider the case of adjoining houses with a party wall, two stories high, 20-ft. front, walls 20 ft. high, with a live load of 40 lb. per square foot and a dead load of 20 lb. per square foot on both floors and roof; 8-in. brick walls. Assuming that the weight of the masonry to be 140 lb. per cubic foot, and computing the loads, we find that the load on the lowest mortar bed on the outside walls is 36 lb. per square inch and for the party wall is 57 lb. per square inch, no allowance being made for openings. In fact, we may carry the building up to eight stories, increasing the wall thickness 4 in. for each additional 20 ft. of height before the load on the lowest mortar bed becomes 100 lb. per square inch.

Tests Made in Brick Piers

The following table presents a summary of many tests made on brick piers laid up in lime mortar. The results indicate that in all cases the ultimate crushing strength is from 10 to 20 times the permissible load:

Authority	1-3 lime (lbs. per sq. in.)
The Clay Worker, 1917	1073
Bureau of Standards	....
Watertown Arsenal	1379
Watertown Arsenal	1941
Watertown Arsenal	1767
Columbia University	1950
Average	1622

It would appear, therefore, that ordinary lime mortar is amply strong for any type of small house construction, and for the average apartment building as well.

Let us consider what happens when cement is added to the lime mortar. This is a common practice when quick hardening is essential and when the strength requirement is unusually severe. Professor. Macgregor conducted an extensive series of tests at Columbia University some time ago in which he studied the effect of mortars on the strength of ma-

*Address before the Sand-Lime Brick Association in annual convention at Dayton, Ohio, on February 1 and 2, 1922.

sonry piers. He used seven different types of mortar, ranging from a straight lime mortar to a straight cement mortar. The interesting feature of these tests is that the 50-50 mortar, composed of 1 part lime, 1 part cement, and 6 parts sand by volume, produced stronger piers than did the straight cement mortar. The average results with cement mortar at 28 days were 2840 lb. per square inch with face brick and 1170 lb. per square inch with common brick, while with the 50-50 mortar the results showed 3100 lb. per square inch on face brick and 1300 lb. per square inch on common brick. In those special instances where exceptionally high strength is required we should use a lime-cement mortar rather than straight cement mortar.

Professor Macgregor discusses his results as follows: "First, the replacement of portland cement by hydrated lime renders a more plastic mortar which spreads easily on brick work, and in consequence insures more uniform bedding, and this with less care. Secondly, the so-called 'suction' of the brick which steals a great deal of moisture from portland cement mortars has been noted as affecting hydrated lime mortars to a much less degree. The addition or replacement by hydrated lime aids in the retention of moisture. Thirdly, moisture which is least due to causes cited probably leaves the mortar with an insufficient amount to completely hydrate or properly hydrate the portland cement, a condition which is largely overcome by the use of hydrated lime."

Complete Bedding Necessary

The man on the job seldom appreciates the reason for insisting upon complete bedding of the brick, and consequently does not take particular care to see that it is obtained. If he is required to work with a stiff and harsh mortar he will spread it in the easiest way for himself and not worry as to whether the brick is fully bedded, which, of course, decreases the strength of the wall. The superior plasticity of lime mortar, as noted by Professor Macgregor, enables him to handle more mortar on his trowel, thus encouraging a more liberal use and consequently a fuller bed and at the same time affording a bed in which the brick may be easily and satisfactorily laid.

The adhesiveness, the ability, of the mortar to stick to the bricks is a particularly important feature. With cement mortar the cohesion is the strongest factor. Numerous tests have been made to determine the effect that lime has on the adhesive qualities of cement mortar.

Mills, in his "Materials of Construction," says: "Tests made with mortars to which lime paste has been added showed that the addition of 10 per cent of lime increased the adhesive strength from 120 to 140 per cent; 16.7 per cent lime added increased it from 130 to 160 per cent; 25 per cent lime added increased it to from 110 to 120 per cent; 50 per cent lime added increased it 75 to 80 per cent. The addition of lime increased the ratio or adhesion to cohesion in all percentages."

Sabin reports similar tests in his "Cement and Concrete," showing increases up to 130 per cent when lime paste is added to cement mortar.

The data presented in this discussion may be considered as entirely applicable to sand-lime brick construction. The value of lime mortar for laying up brick walls is evident. Not only has it been proved to be amply strong, but we also have its manifest economy. It has no waste through setting up because of minor delays; it is easily prepared, and it is easily handled. The ease of handling not only improves the character of the work, but speeds up construction as well. It is not uncommon to have men in the mason trades say that they can lay from 30 to 50 per cent more brick per day when supplied with lime mortar than they can lay with other mortars. The number of brick laid per day thus depends to a large degree upon the type of mortar specified, and if we want to increase production we should aid the workman by specifying lime mortar rather than blaming him for decreased production that actually is caused by the mortar specified.

Co-operation between industries is essential to success, and the lime industry feels a close bond to the sand-lime brick industry. The lime manufacturers of this country are equipped for both quality and quantity production, which, of course, implies the most economic arrangements and correspondingly reasonable prices. The National Lime Association is interested in maintaining a high standard for lime and its uses. We will be glad to cooperate with you, to discuss with you your special requirements, and to help you solve your problems.

Rates Still Retard Industry in Iowa

AT the March 15 meeting of the Iowa Sand and Gravel Producers' Association, at Mason City, general business conditions were discussed as well as the effect of present freight conditions upon the sand and gravel industry. This industry is being seriously hampered by the freight rates as they are limiting the average producer to a very small territory and in consequence the large producers in Iowa cannot operate their plants at a maximum production, which means a minimum cost, says Secretary Graham.

This condition is responsible for the steps some producers are taking in diminishing their plant capacity—and this means a higher net operating cost.

These freight rates, stated Secretary Graham, are also responsible for the excessive use of pit-run material in Iowa. Such material is universally recognized as unsuited to concrete work, but at the present time, price seems to have more weight with the buyer than quality.

The Iowa state highway program at present calls for but little construction work in the northeastern part of the state, and therefore business is very slow in starting up.

Proposes Duty Free Cement for Louisiana

AT a recent meeting of the building committee of the Louisiana State University, Governor Parker announced that he had taken up with the government at Washington the question of bringing into Lousiana, duty free, the cement necessary to build the state university, upon which will be spent between $6,000,000 and $7,000,000.

Governor Parker declared that cement can be bought at a much lower figure than domestic prices, and has taken the position that Louisiana, as a sovereign state, could import its own cement without paying duty.

Washington has told the governor that this is a new question and would have to be passed upon by the Secretary of the Treasury. No decision has been given by Secretary Mellon as yet.

Building Exposition at Cleveland

THE American Building Exposition will open the new Municipal Auditorium, Cleveland, Ohio, on April 22, to continue for 11 days. The exposition will show every character of building material, interior decoration, finishing, furnishing and equipment, and an unusually interesting architecural display.

The aren, or street level floor, will be devoted entirely to structural materials. The main exposition floor will carry exhibits of all that goes inside the home or commercial building. In addition there will be a machinery section in the corridors of the arena floor.

Alpha Cement's 1921 Report

THE Alpha Portland Cement Co., for 1921 reports a net profit of $672,338, after depreciation and usual reserves including Federal taxes and adjustment of inventories. Gross sales amounted to $10,717,546. Expenditures for improvement and extension of plant in addition to regular repair and maintenance were $678,793. Dividends paid last year totaled $850,970. The profit and loss surplus on December 31, 1921, was $2,239,638.

Alunite Deposits in United States*

A Little Known but Wonderfully Valuable Mineral of Great Importance in the Nation's Industries—Sources and Development

By Richard Hoadley Tingley

ASK almost any layman to tell you the nature of potash or its products and he will have some more or less accurate information to impart; or about aluminum or sulphuric acid—again, your man will have some kind of inadequate information on the subject.

Alunite, as a basis of potash, aluminum and sulphuric acid is comparatively little known. It is too new a discovery yet to have made much of an impression on the market and the man-on-the-street knows not of it.

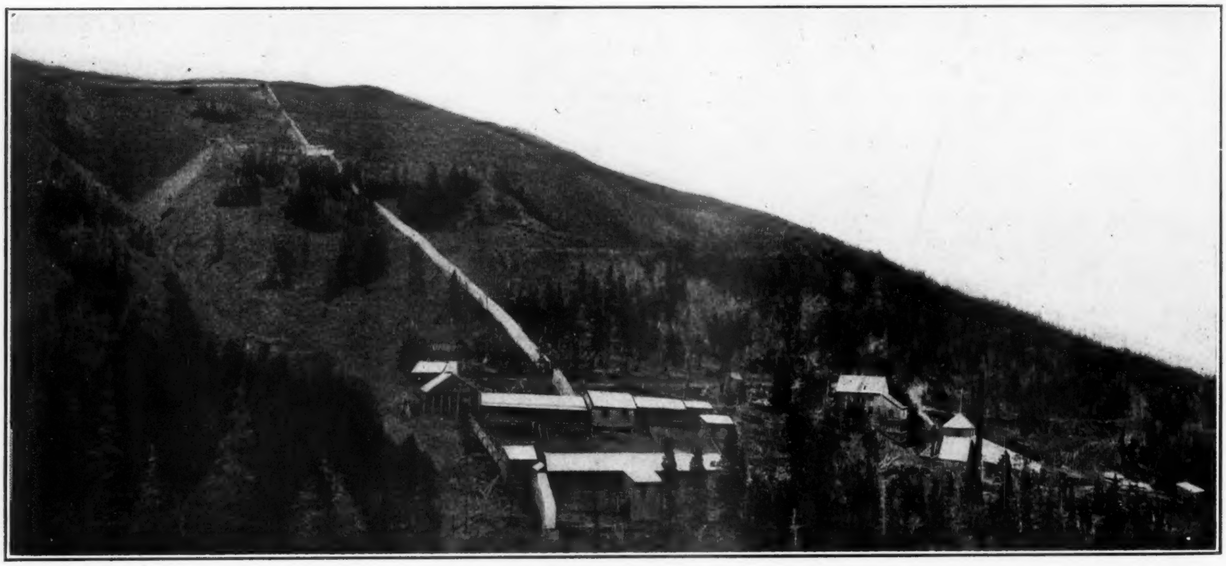
Ten thousand feet up in the Tushar Mountains, in Piute county, Utah, near Marysvale, about 200 miles south of Salt Lake City, miners are working in shafts and tunnels with rock drills, air compressors and dynamite, blasting out a hard, pinkish tinted "spar"—alunite.

About a dozen years ago a group of Philadelphia capitalists were operating in this mountain range for gold. They found plenty of the yellow metal, but they found a great preponderance of "pink spar" deposit and they drilled and blasted through it. Belonging to the 99 out of 100 that probably had never heard of alunite, they threw it into the dump and continued their search for gold. A keen observer—a prospector named Ole Larsen — suggested alunite.

A chemical engineer, W. T. Schaller, in the Government employ, made an investigation and analysis which was published by the United States Geological Survey, December 18, 1911, in Bulletin No. 30, which demonstrated the feasibility of extracting potassium sulphate from the pink spar. At this the Armour Fertilizer Co. of Chicago "woke up," for it needed potash to compete with the German market, and developed on a commercial scale the process Schaller had theoretically worked out. Under the wing of their Mineral Products Co. the Armours acquired claims in the Tushar Mountains and erected the first mill in this country for the treatment of alunite, making its first shipment of potassium sulphate of 28 tons, said to be 93 per cent pure, to the Armour Fertilizer Co.'s works at Jacksonville, Fla.

Since Schaller's report chemical engineers have been active in alunite and have largely if not fully developed its many uses and values in the commercial field. They have determined that the Tushar Mountain alunite is a double sulphate of aluminum and potassium from the treatment of which, in one way or another, it is possible to extract potash, aluminum and sulphuric acid. In order to show the importance of alunite through its components in the principal products of manufacture, as well as the supplemental derivatives into which the manufactured products may be divided note the accompanying diagram.

The value of the discovery of alunite will be seen from the fact that it opens an entirely new source of supply for its three active commercial products—potash, aluminum and sulphuric acid, in quantities of vast proportions, for there is quite a notable tonnage of this "pink spar" on the dumps and in sight opened up by the many tunnels, shafts and cuts, and probably a considerable supply that has not yet been reached.



One of the camps and the mountain plant of Florence Mining and Milling Co., developing a large body of high-grade alunite near Marysvale, Utah

It is predicted that a revolution is due in the market for these commodities for, owing to the nature of the rock, it can be roasted and treated for its component parts at the minmum of expense. Whatever product of alunite is primarily sought to be produced, another product is obtained at practically no cost; thus, if the production of metallic aluminum is the primary object, sulphate of potash and sulphuric acid will be obtained as by-products. If, on the other hand, the production of sulphate of potash is the primary object, then alumina—the basis of metallic aluminum—will be obtained as a by-product and at no additional cost.

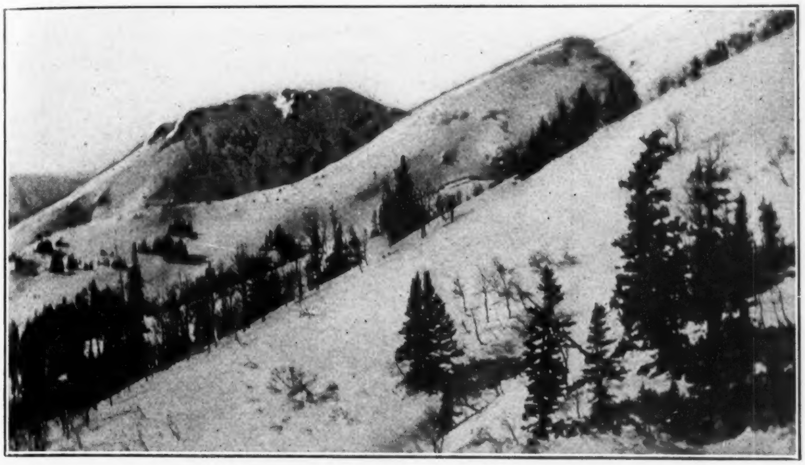
*By courtesy of "Compressed Air Magazine."

Sources of Alunite

According to Paul J. Fox, formerly of the Bureau of Soils, Department of Agriculture, the deposit of alunite in Utah is one of the largest in the world and also of a high degree of purity and will not be of much difficulty to work. Since gold often occurs associated with alunite there have been frequent discoveries of that mineral from time to time by gold seekers in various sections of the United States and elsewhere. The deposits that compare most closely with those of the Marysvale district are at Tolfa, Italy. The largest of these is the Providenza vein which has been worked to a depth of 300 ft. These deposits, known and worked since the thirteenth century, have a chief value in Europe as a producer of alum which enters the market in competition with artificial alum made from German potash. The volume of the Italian alunite, however, is too small and scattered and too poor in quality to compete with the product found in the mountains of Utah.

In Australia there have been several alunite veins discovered by gold miners, and near Sulphur, Nev., alunite has been found and some development work done. In every instance the quantity has been limited and the grade inferior. Considerable possibilities may yet be realized in the development of the alunite deposits of Marysvale and they may well repay efforts to exploit them.

Geologists say the Tushar Mountain alunite is a volcanic emission from Mount Edna, a long extinct crater, and that the alunite deposited nearby is of the purest quality, becoming contaminated as the lava flowed out over the adjoining country. Mount Edna is on the property of the Florence Mining and Milling Co., Philadelphia, where Ole Larsen originally discovered alunite. Nearby is the property of the Mineral Products and the Swift companies of Chicago. Several other companies are working or have worked in alunite in this general district since Schaller's discovery; the Utah Potash Co. near Belknap; the Pittsburgh Utah Potash Co., which controls deposits in Deer Canyon near the Sevier river; the American Smelting and Refining Co. at Yellow Jacket, near Twin Peaks, and others. Some are developing for alum; some for potash; some treat the ore on the spot, while others ship it away for treatment. On account of their proximity to the original source of supply—the Edna Peak—the first three companies are the only ones operating in pure alunite.



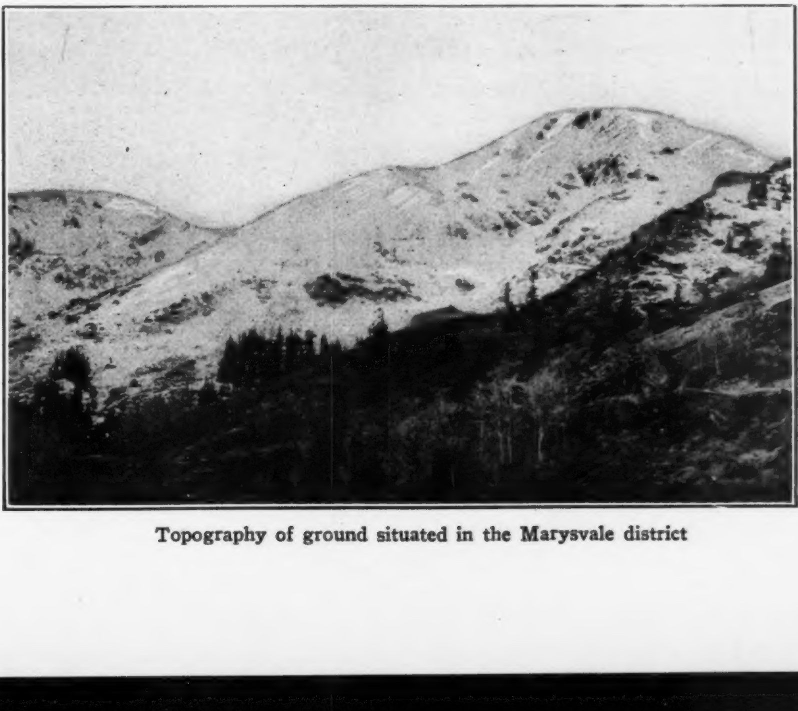
Part of the property of the Florence Mining and Milling Co.

By far the largest of these properties is that of the Florence Mining and Milling Co. This company controls and operates 89 proved claims of 20 acres—1780 acres in all. Its workings consist of 50 shafts, tunnels and cuts aggregating nearly two miles in length into the mountain. Nearly all of these openings are in alunite—and a large tonnage at least—in sight. Partial developments on other claims show still greater quantities. The owners say but little about the latter, however, partly because the exact quantity has not yet been proven, and partly because they say this tonnage is sufficient for any reasonable man to ask for at one time.

At the base of the mountain on the highway the company has its 50-ton lixiviation plant where the ore comes tumbling down the mountain in chutes from the tunnel mouths far above, and is crushed, roasted and prepared for shipment. Power is supplied by the Telluride Power Co., whose high-tension lines pass through the property. The treated ore is transported to the railway at Marysvale, 12 miles away, by trucks over the wagon road. When developments have reached the proper stage it is the intention of the company to install a cable tramway capable of transporting large quantities of ore at small expense, cutting down the distance nearly a half, so circuitous is the highway as it winds through the valleys.

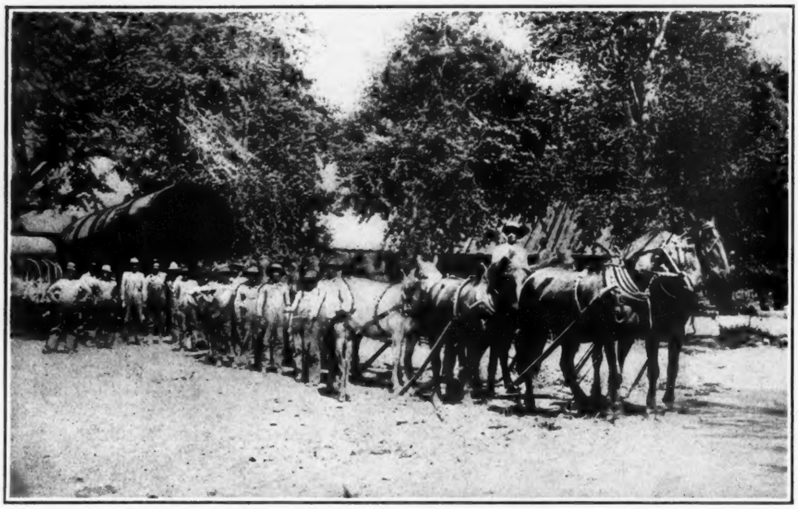
The Mineral Products Co.'s property is smaller in size than the Florence, which it adjoins, and its alunite in sight and in prospect is less in quantity, though not proportionally so. It has, however, advanced far commercially, and has placed potash derived from alunite on the market in large volume, its daily production being about 35 tons. Equipping itself for business while the war was on it enjoyed all of the prosperity that came to the potash industry during that period. During this time the company fully demonstrated to the trade generally that was closely watching, that alunite was all it had hoped it to be, and that the predictions of its engineers who conducted the original experiments and examinations were fully justified and verified.

On the properties of the Florence and Mineral Products companies the alunite occurs in such a solid, compact mass that little timbering is required. Drilling is



Topography of ground situated in the Marysvale district

done with Ingersoll-Rand stopehamers, using 1⅛ in. cruciform steel. Jackhamers are used for block holing of large boulders in the stopes and for sinking winzes.



Hauling the big 110-ft. rotary kiln to the mill. A section of this pipe measures 35 ft. in length

Blasting is done with 40 per cent straight dynamite and 40 per cent gelatine. Air for drilling is supplied at 90 lb. pressure by compressors having capacity of 1050 cu. ft. of air per minute. A 30-deg. Beaume distillate is used for fuel. From the stopes of the Mineral Products property the ore is drawn in 20 cu. ft. capacity cars and delivered to the loading bin of an aerial tramway, 6200 ft. long, which delivers the ore in 6½ cu. ft. capacity buckets to bins at lower terminal, and from there is hauled by wagons to the mill, 4½ miles away.

Both the Florence and the Mineral Products properties have long since passed the mining development and promotion stage. They have fully demonstrated that there is enough alunite near the Edna crater to fulfill all the needs that can now be foreseen for years to come—and then a lot more. They have spent years doing this and in further developing the fact of the commercial possibilities of extracting potash, aluminum and sulphuric acid from a hitherto unknown source. In this operation thus far it has been experimental work that has largely occupied their attention. They were learning what alunite was worth and how to make the mining and treatment of the ore pay at a time of high prices and large demand, and it is said that at least one of these companies made a good showing in the operation on a small original investment.

But the scenes have shifted. The market for their product has been demoralized along with the market for all other products, and these companies are now reorganizing the working economies of their plants and operations to meet peace-time competition in price from both at home and abroad—and the competition will be keen. Pioneering is usually a hazardous operation, but at least one of these companies had the rather unusual experience and good fortune of pioneering in a market whose intensive demand for their product practically eliminated the hazard.

Potash

When the term "potash" is used it is understood to mean potassium oxide (K_2O). Potash salts are not used in the form of potassium oxide but as potassium sulphate, potassium chloride, etc. By the term potassium sulphate is meant potassium oxide (K_2O), combined with sulphur trioxide (SO_3), making the compound (K_2SO_4). Potash salts are essential in numerous industries, the most notable being the fertilizer industry. The salts are used in the manufacture of glass, explosive powders, certain kinds of soap and in the chemical industries, including the manufacture of alum, cyanides, bleaching powders, dyestuffs, match tips and other chemicals. Note the accompanying table.

POTASH IMPORTS—(SHORT TONS)

(From reports of U. S. Geological Survey.)

	Crude	Available K_2O	Value
1905	....	129,084	....
1906	....	155,974	....
1907	....	144,351	....
1908	....	136,057	....
1909	....	173,320	....
1910	....	179,780	....
1911	....	174,446	....
1912	....	153,678	....
1913	1,092,588	270,720	$18,073,865
1914	798,087	207,089	15,421,611
1915	116,686	48,867	6,258,348
1916	26,642	7,885	7,425,398
1917	25,287	8,100	7,788,406
1918	24,419	7,957	8,907,836
1919	160,846	39,619	10,191,816
1920	947,176	201,927	33,942,181

SAME, FOR FIRST SIX MONTHS OF 1921

U. S. Potash Producers' Association

	Crude	Available	Value
January	33,110	5,990	$1,063,552
February	29,667	6,857	1,189,677
March	22,949	5,951	1,113,963
April	8,720	2,334	419,565
May	5,116	1,399	244,210
June	534	231	33,421
Total	100,096	22,762	$4,064,388

Up to the war the use of potash was increasing rapidly, but its use in this country has hardly begun. It is just commencing to strike the West and it is very likely that within a few years the total use throughout the United States will be double that of 1913. Stocks of potash held in this country are variously estimated at from 50,000 to 80,000 tons. According to the United States Potash Producers' Association they are small compared with the potential demand. Reports state that this country used in 1920 at least 200,000 tons and possibly 225,000 tons. In 1921 the consumption will be far below that figure because of

A Florence milling plant

the so-called farmers' strike, which was not so much of a strike as sheer inability to pay.

The 1921 consumption of potash will, according to the best authorities, not be more than 75 per cent of the 1920 consumption, say, 150,000 tons. Even this amount is close to three times the quantity said to be on hand. Next year, with fertilizer prices down, there is good prospect for a largely increased use of potash even possibly up to the 1920 consumption.

Hauling wood in winter under conditions prevailing in the district

In that event, what will become of the 50,000 or 80,000 tons now in stock and what will happen to prices? Many American plants are closed. Germany has stopped shipment, France has almost stopped and stocks on hand are something like a quarter of the demand which may be expected according to the Potash Producers' Association. These facts have been under consideration of those interested in the development of alunite deposits for some time.

An accompanying table gives the United States production of potash for the past few years from which will be seen the rapid increase since the German supply has been shut off. It will also be seen that at present alunite cuts but a small figure, contributing but 5 per cent of the total in 1918 and 7.4 per cent in 1919.

POTASH PRODUCED AND SOLD IN THE UNITED STATES (IN SHORT TONS)

	Crude	Available K_2O	Value
1915	4,374	1,090	$343,000
1916	35,739	9,720	4,242,730
1917	126,961	32,573	13,980,577
1918	140,343	38,580	15,839,618
1919	173,786	46,732	11,370,445

POTASH OBTAINED FROM ALUNITE RECORDED IN FOREGOING TABLE (IN SHORT TONS)

	Crude	Available K_2O	Value	Per cent of total
1918	6,180	2,621	$1,276,774	5
1919	6,594	2,293	683,055	7.4

(From Reports of the U. S. Geological Survey.)

The price of potash has fluctuated widely, running as high as $10 a unit of 20 lb. in 1915 to as low as $1.85 in 1920 and approximately $1.35 this year, as will be seen from the table.

WHOLESALE PRICE OF POTASH (PER UNIT OF K_2O)

	High	Low	Average
1915	$10.00	$2.30	$5.90
1916	9.80	6.00	7.60
1917	9.00	5.50	7.60
1918	7.00	5.20	6.30
1919	3.25	2.00	2.70
1920	2.80	1.85	2.40
1921	......	......	1.35

In pre-war times the German product sold at around 75 cents a unit, and it has been found that the use of fertilizer by the farmer is largely an economic problem. When potash is high he uses little; he goes without it. This will be seen by reference to the table which gives the approximate use at different prices:

With unit price of	Probable yearly use
$5.00	45,000 tons
2.50	90,000 "
2.00	112,000 "
1.50	150,000 "
1.00	225,000 "
.75	300,000 "

—From "Mineral Industry," 1919.

With the advent of settled business conditions it is the hope of alunite workers to produce potash at a price low enough to bring out the maximum of demand from the farmer.

It will be seen from the foregoing and from the tables and graphs that the potash industry of the United States has long enough been dominated by Germany and, on account of the numerous and extensive uses of the potash salts, it is essential that the industry be permitted to establish itself firmly in this country. Great strides have been made in this direction but, like all "infant industry," it should have a little protection at the hands of Congress, and the modest tariff of 50 cents a unit for the next two years, graduated down to 40 cents, 30 cents and 20 cents in the fifth year, after which time no protection will be needed seems most reasonable.

Alumina

The alunite deposits of Marysvale contain 37 per cent of aluminum oxide. Alumina is a white powder and is the material from which the metal, aluminum, white in color and light in weight, is made. Alumina is 53 per cent aluminum. The nearest thing occurring in nature to alumina is bauxite, found for the most part in Georgia and Arkansas. Bauxite, according to Fox, contains 50 per cent alumina (26.5 per cent metallic aluminum), the rest being clay, earth, sand, iron and water. It is formed in superficial deposits in pockets running into clay and requires a chemical analysis to determine how much alumina it contains. Bauxite is contaminated with iron, silica and lanthanum, which increase the expense of making the pure alumina necessary for manufacturing aluminum. None of these impurities have any commercial value, their removal but adding to the expense.

Undoubtedly more interest will be taken in developing known deposits of aluminum minerals and prospecting for others, inasmuch as the development of the airplane engine will require large quantities of this exceedingly light material. Other uses of aluminum and its alloys of course will require large quantities. It is now a known fact that combined with certain other elements the tensile strength of aluminum can be largely increased and therefore because of its comparative lightness a good many other fields may be opened up for its use.

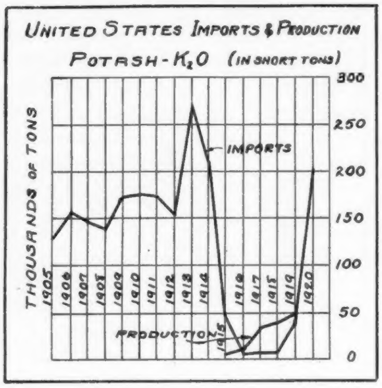
Alunite is alumina mixed with sulphate of potash, or alumina mixed with alum, according to the way it is treated. Leaving aside the sulphuric acid, the potash and alum are both valuable, and can be separated at a small expense. The market for alumina in the manufacture of aluminum is world-wide and active search for new sources of supply is now going on.

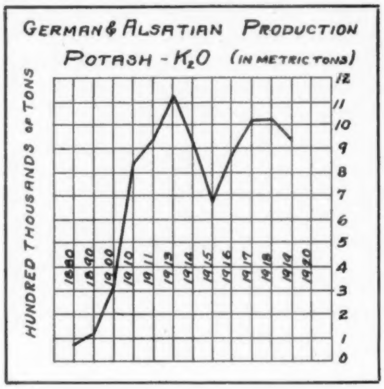
An aluminum manufacturer, using the Mount Edna alunite, has the alumina free

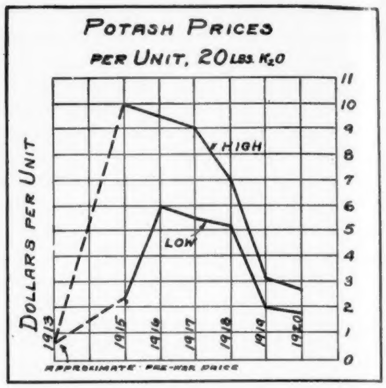
Hauling alunite by motor truck from 11,000-ft. elevation

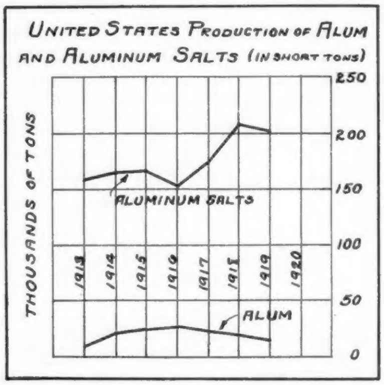
if he chooses to so regard it for the alum, potash and sulphuric acid will, according to the best of authorities, more than pay for all mining, transportation and manufacturing charges. This fact would constitute a great advantage to producers of alunite when the market of either potash, alumina or sulphuric acid is considered. A manufacturer can, if he desires, warehouse at least one of the products and wait a favorable market while covering himself with the other.

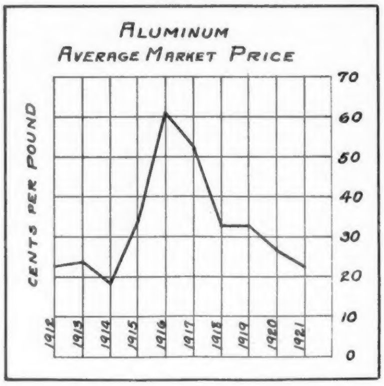
A table on the next page shows the imports, exports and apparent consumption of aluminum, taken from government reports:

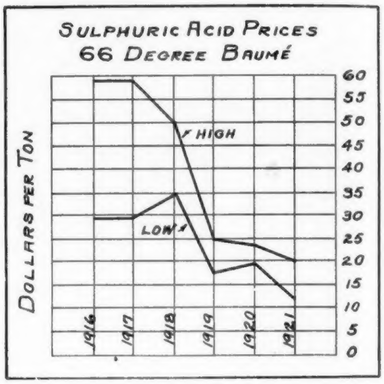












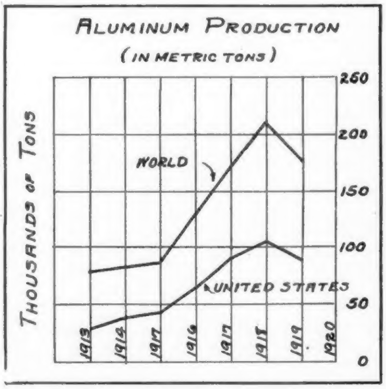
WORLD PRODUCTION OF ALUMINUM
(METRIC TONS)

1913	29,500	in United States;		79,590	total
1914	40,600	"	"	" 84,957	"
1915	45,000	"	"	" 88,394	"
1916	63,000	"	"	" 130,626	"
1917	90,700	"	"	" 173,240	"
1918	102,000	"	"	" 208,215	"
1919	90,000	"	"	" 173,000	"
	*115,000	"	"	" 257,000	"

*Estimated capacity.

AVERAGE PRICE OF ALUMINUM
(CENTS PER POUND)

1912	22.01	
1913	23.64	
1914	18.63	
1915	33.98	
1916	60.71	
1917	52.00	
1918	33.00	
1919	27.00	
1920	22.75	
1921	22.75	June 30



Alum and Aluminum Salts

Although not met with in quantity in ordinary life, alum is an important and widely used article in the chemical industry. It has been a staple for a long time and its application is rapidly increasing in this country on account of the development of the dye industry. Alum has other uses, in making bread, in lithography, in paints and enamels, textiles, printing, paper, leather, tanning, portland cement and in softening water. Various substitutes, mostly on account of their cheapness, have come into use for alum, principally aluminum sulphate, of which the quantity consumed is far greater than alum.

ALUMINUM
UNITED STATES PRODUCTION, IMPORTS, EXPORTS AND APPARENT CONSUMPTION

	Primary metal	Secondary metal	Imports	Exports	Apparent consumption	Imports, pounds
1912	$7,400,000	....	$3,541,591	$1,347,621	$9,593,970	....
1913	9,450,000	$2,199,480	3,845,611	966,094	14,528,997	....
1914	10,080,000	1,673,140	2,801,211	1,546,510	13,007,841	15,964,042
1915	16,280,000	5,802,100	1,808,193	3,682,117	20,208,176	13,765,172
1916	33,900,000	23,430,200	1,785,870	15,417,134	43,698,936	8,200,528
1917	45,882,000	16,711,800	56,890	14,586,467	48,064,223	1,904,000
1918	41,159,000	10,113,600	554,586	10,869,388	40,957,798	1,503,776
1919	38,558,000	....	4,568,595	3,890,326	....	6,822,616

(From reports of U. S. Geological Survey.)

Alunite is considered by many, according to Fox, to be incomparably the best material for the manufacture of both alum and aluminum salts. He considers that, properly pushed, it will drive out every competitor, domestic and foreign.

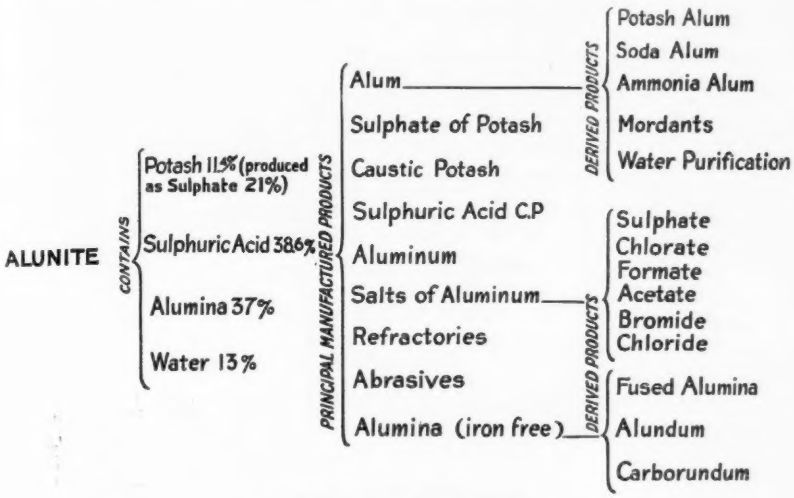
A certain strategic, almost monopolistic position in the market belongs to the owner of an alunite property. Owing to its freedom from iron and to the small expense of making it, alunite yields the preferred alum at as low a price as aluminum sulphate can now be sold.

Sulphuric Acid

When alunite is heated it yields as an exit gas 29 per cent of its weight of sulphur dioxide and oxygen in the proportion of one of the dioxide to one-half of oxygen. The sulphur dioxide-oxygen exit gas is pure and free from undesirable chemical constituents, is of high concentration and contains all the oxygen necessary to make sulphuric acid. These salient facts, says Fox, make it apparent that the contract process is the advantageous one for making alunite acid, and that alunite can cheaply produce without any purification of the gas the most perfect sulphuric acid possible to prepare, chemically pure, and suitable for use in making acid phosphate, baking powder and the like. Alunite gives off three-quarters of its combined sulphuric acid in heating, the other quarter remaining with the potash to form the potassium sulphate. The to-

tal sulphuric acid is 38.6 per cent, the amount yielded in heating is 29 per cent of weight of the raw alunite.

Prior to the war the yearly output of crude sulphuric acid calculated on the basis of 50 deg. Beaume was about 3,600,-



ALUNITE—ITS COMPOSITION, PRINCIPAL PRODUCTS AND A FEW OF THE NUMEROUS DERIVED PRODUCTS.
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000 tons. The war raised this figure to as high as 9,600,000 tons, which fell off again in 1919 to approximately the old amount. The industry is now suffering from the decline in all lines of business and a surplus stock apparently exists in this country which has driven the price of the crude product down to a very low point —$10 or $12 a ton of 60 deg. acid and about $18 to $20 for the 66 deg., although the chemically pure acid is worth today around $200 a ton, with a comparatively limited demand.

SULPHURIC ACID PRICES: 66 DEG. (CRUDE) (DOLLARS PER TON)

	High	Low
1916	60	30
1917	60	30
1918	50	35
1919	25	16
1920	24	18
1921	20	12

—"Oil, Paint and Drug Reporter."

The great mass of alunite of the Marysvale district is unique in itself and offers rare business opportunities. Besides being the only body of alunite in the world of industrial importance, it is so immense in size that it is capable of forming the basis for a whole series of industries for an indefinite number of years in potash, aluminum, alum, aluminum salts, alumina, sulphuric acid and their derived products. It would be no exaggeration to call it a monopoly.

Considered as a mineral deposit alunite also is unique in that there is no need of assaying, for values for the whole vein used.

A further advantage is claimed by the owners of the Marysvale alunite near Mount Edna in that it guarantees that prime requisite for a manufacturing industry of a practically unlimited supply of raw material of uniform quality. In this it differs from bauxite, where continual change is the rule. It offers no difficulty in mining or grinding and can be roasted at a moderate temperature, which means economy in fuel. It can be stored and shipped without deterioration, and the processes of working up, unlike much chemical manufacture, do not require large and expensive plants or great capital outlay.

When the business clouds disappear and industry again resumes a normal basis, manufacturers in alunite expect to find a commercial advantage in the development of deposits of this mineral for its products and derivatives for the simple reason that, in working for one of the products, the others are produced at practically no additional cost.

Will Write a History of the Sand and Gravel Association

IT is announced in the March *Bulletin* that its editor, T. R. Barrows, will write a history of the National Association of Sand and Gravel Producers. The material will be secured from the association minutes as recorded by its executive secretary, E. Guy Sutton, during the six years of its existence.

The first installment of the history, a gossipy, informal sort of a narrative, will appear in the April *Bulletin*, and suggestions, photographs or anything relating thereto will be appreciated by Mr. Barrows.

Boston Urges Material Tests

BOSTON'S finance commission has found certain defects in the contract for furnishing crushed stone to the city. For protection, declares the commission, future specifications should determine the quality by tests.

The commission recommends that before contracts are signed for crushed stone the contract be changed to place the responsibility upon the head of the department using the stone, rather than upon the superintendent of supplies; that the departments using crushed stone establish standards that the qualities be determined by tests for hardness, toughness and abrasion, and that the provisions relating to determination of the amounts of stone furnished, the submission of bills and payments to the contractor be so changed as to make clear the duties of each party to the contract.

The man in the picture is Ole Larsen, a famous prospector and the discoverer of alunite. He is standing on a 60-ft. solid alunite vein

California Silica Sand Operations*

Del Monte Properties Company Operates a Modern Washing and Drying Plant at Lake Majella—White Sand Deposit

By A. J. Gunnel
Del Monte Properties Co., San Francisco, California

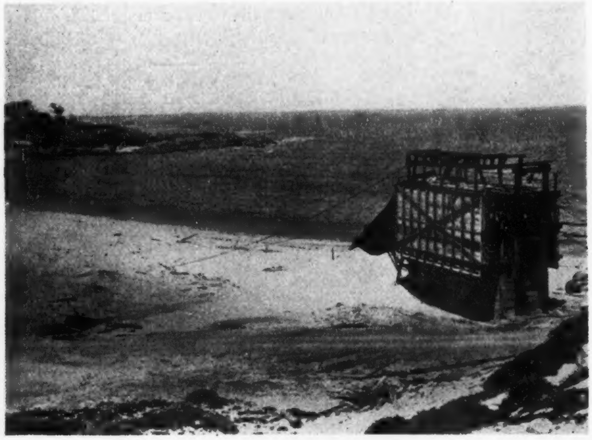
THE white sand beaches and dunes of the ocean front of the Monterey peninsula, California, were perhaps as interesting to the discoverers of Monterey bay and to Father Serra and his followers as to the thousands who have wandered over them in more recent years. Artists have painted and photographed them so faithfully that their beauties are familiar to people of many lands.

Opposing currents of titanic force meet on the face of the peninsula and their action on the boulders and ledges of the ocean floor produces the beautiful white sands dashed up by the waves on the beaches and shaped by the winds into the wonderful dunes.

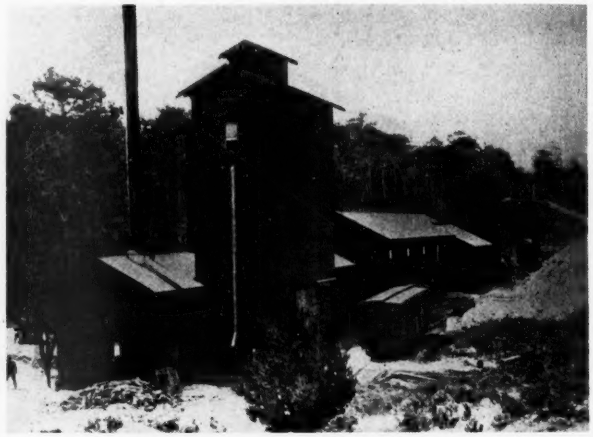
Aside from their artistic charm these sand deposits have utilitarian values which have been so developed since their pioneer uses for plastering and engine sands, as to have become one of the principal operations of the Del Monte Properties Co.

Deposits and Excavation

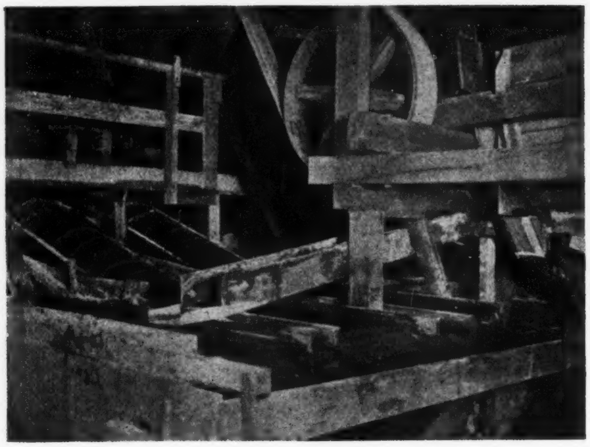
Sand is loaded from two deposits; that at Fan Shell Beach, a great beach of coarse-grained sand lying between the Seal Rocks and the point where the Old Ostrich Tree stood, as one approaches Cypress Point. Here a dragline carries the sand from beach to storage bins alongside the drive, which discharge to trucks transporting the sand seven miles to the main plant on the track at Lake Majella. The other deposit is at Lake Majella, the terminus of the Monterey branch of the Southern Pacific Co. Here the Del Monte white sand is hauled by dragline from the dunes, and both sands are loaded to railroad cars in a crude state as they come from the deposit, or after having been washed and dried.



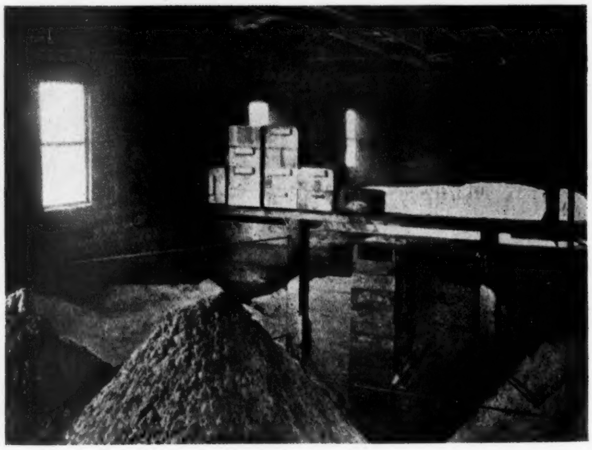
Fan Shell Beach



Plant at Lake Majella



Log washers

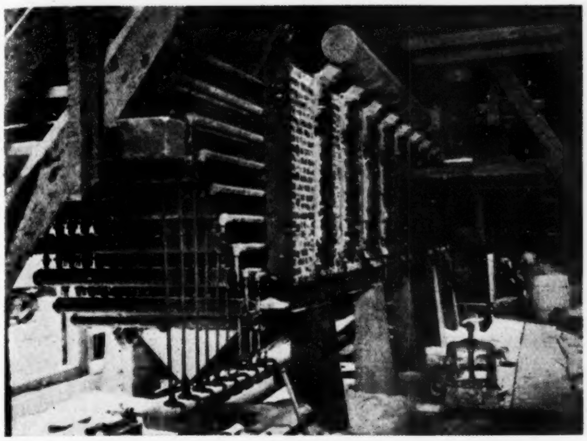


Drainage room

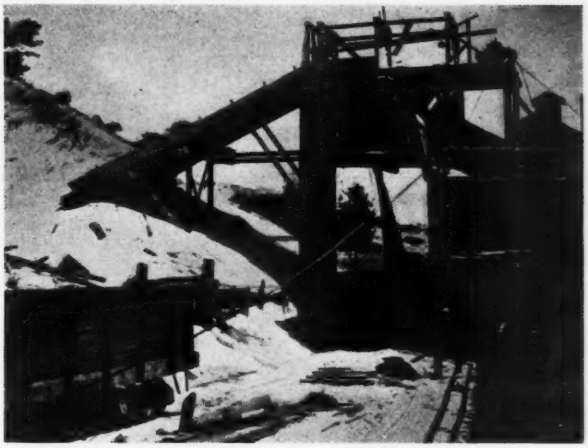
Washing and Drying Plant

At Lake Majella is the washing and drying plant, which was completed and began operation on February 1, 1921. This plant is equipped to handle both

*Reprinted from November issue of *The Architect and Engineer.*



Steam drier



Loading track at Lake Majella

sands, washing in fresh water, draining, drying by steam, and is the most approved type of plant used in Pennsylvania and West Virginia for treating the silica sands produced in those states for the glass industry.

Sand is discharged from dragline or truck into a bin from which—fresh water jets playing upon it—it is fed into a double revolving screen which eliminates most of the impurities; thence it goes to batteries of logwashers, the process of traveling from bottom to top of the log, down over riffles to the bottom of the next log, and so on, constantly under action of water, until discharged to the conveyor, it completes a thorough washing and the sand is ready for the drainage room to which it next proceeds.

On the drainage floors the water which follows the sand from the time it enters the plant is mostly lost. In a damp state it is discharged to a belt conveyor running under the bottom of the drainage floors and delivered to a conveyor in the drying room, running to and along the top of the 35-ft. steam drier.

This drier is a great battery of steam pipes returning waste steam and condensation to the boilers. Into this battery of pipes the sand is tripped from the conveyor and working down as it dries, discharges bone dry into a triangular bin at the bottom of and the full length of the drier. From this bin it falls through small circular openings to a belt conveyor delivering to a bucket elevator running to the top of the storage house, there discharging through a final revolving screen to chutes leading to various storage bins. From the storage bins sand is loaded direct to paper-lined box cars, or goes to the sacking room where the sacks are filled, closed and sewed by machine, and then loaded on the cars.

Uses of Sand

These sands, largely used industrially, are valuable for their high silica content, very small percentage of iron, sharpness of grain and freedom from silt, and are in especial demand since they can be supplied thoroughly cleaned, washed and dried, in all seasons. They are used for making glass, for foundry cores, facings and castings, for sand blasting, roofing, plasters, stuccoes, mortars, artificial stone work, filtration, golf courses and many other purposes—not the least of which is for children's playground sand boxes, municipal and private. The territory to which they are shipped covers California, Oregon and Washington—the entire Pacific Coast from San Diego to Vancouver and Victoria—and the Hawaiian Islands.

Constant experimentation and research is prosecuted in efforts to completely eliminate any impurities which would interfere with the use of the sands for specific purposes. Mother Nature co-operates in maintaining the supply—the waves work incessantly and the winds are no slackers—and as the dunes gradually rebuild as they are worked down and the beaches renew themselves each season, it is safe to say that the deposits of Del Monte and Fan Shell Beach white sand are inexhaustible and will be available as long as the Pacific beats and caresses the coast of California.

Fluorspar in 1921

THE fluorspar shipped from mines in the United States in 1921, according to Hubert W. Davis, of the U. S. Geological Survey, amounted to approximately 65,600 net tons, a decrease of 81 per cent as compared with 1920. The general average selling price per ton f.o.b. cars at shipping points for all grades of fluorspar in 1921 is estimated at $19.89, which is $5.37 less than the average price in 1920. The total shipments in 1921 were the lowest recorded for any year since 1908. The shipments from Kentucky exceeded those of Illinois for the first time since 1904.

Imports of fluorspar into the United States in 1921 showed a decrease of 75 per cent as compared with those in 1920. The imports in 1921 were equivalent to about 22 per cent of the domestic shipments of fluorspar of fluxing grade, as compared with about 16 per cent in 1920.

Reports from steel manufacturers who produce about two-thirds of the basic open-hearth steel made in the United States show that they consumed 46,341 net tons of fluorspar in 1921, as compared with 80.545 tons in 1920. This group of steel manufacturers also reported stocks of fluorspar on hand January 1, 1922, amounting to about 19,800 tons, as compared with 45,125 tons on January 1, 1921. These reports therefore show that these steel plants consumed only 1,216 tons of fluorspar more than they had in stock at the beginning of 1921.

Lime Rock Rates to Be Lowered

FREIGHT rates on lime rock from the San Dimas quarries to Los Angeles, Colton and San Bernardino and points south are to be reduced by the Southern Pacific railroad, according to announcement made by the state railroad commission in San Francisco. The commission has authorized the railroad to make reductions ranging from ½ to 2½ cents per hundred pounds.

The Lime Industry in Pappy Blanton's Time

"WHEN I was a boy," says Pappy Blanton in the Monroe County (Mo.) *Appeal*, "lime was made in the country wherever there was a house to be plastered. A big log heap was made and the limestone broken into small pieces and put on the pile of logs, which were usually of hickory.

"After the logs were burned out the lime was found to be in the same shape the rocks were, but the air soon slaked it and it was just as good and white as the lime of today."

Lime in Cyanidation

The More Lime Used the More Silver Extracted—Gold Extraction Not Affected by Increase in Lime

DOUBLING the amount of lime increased the extraction of silver by 31 per cent, in some tests recently made by W. G. Emminger of the Rochester Silver Corporation, Rochester, Nev. These tests are described in a letter to the editor of the "Mining and Scientific Press" (January 14, 1922), as follows:

"In conducting cyanide tests on Rochester (Nevada) silver ores an unusual and interesting fact was discovered in connection with the use of lime. Most of the oxidized ores from the Rochester Silver Corporation's mine yield 80 to 85 per cent of their silver content by simple all-sliming treatment. The consumption of lime is 10 lb. per ton of ore. In a stope on the main vein a block of ore was found to give an extraction of only 35 per cent. An analysis of this ore gave:

	%
Silica (insol. residue)	86.00
Iron oxide	7.71
Alumina	0.29
Antimony	0.83
Copper	0.05
Lime	0.15
Sulphur	0.82
Phosphoric acid (P_2O_5)	0.80
Loss by ignition (water of combination)	3.05
Magnesia	Trace
	99.70

"From this analysis, antimony would be the only mineral that one would suspect to be the cause of the poor extraction. Other parts of the vein showing 1 to 2 per cent antimony gave an 85 per cent recovery in the mill. It was assumed that in this case a large percentage of the silver was combined with the antimony.

"In determining the lime factor, varying quantities were used, from 1 to 30 lb. per ton of ore. The available CaO in the lime used ran from 85 to 90 per cent. The results of this experiment follow:

	Extraction, %
1 lb. lime per ton of ore	24.5
2½ " " " " " "	26.5
10 " " " " " "	33.0
20 " " " " " "	39.0
30 " " " " " "	40.5

"The experiments were continued and resulted in the following, which are averages from 112 experiments:

	Extraction, %
60 lb. lime per ton of ore	61
80 " " " " " "	80
100 " " " " " "	89
130 " " " " " "	92

"Giving the ore a preliminary lime treatment, washing and then cyaniding gave very poor results. This proved that it was necessary to have the lime present during the cyanide treatment; 35 to 40 lb. of lime per ton of ore was found in the tailing from the experiments which were made with the maximum amount of lime.

Any effort to decrease this loss resulted in lower extraction. As lime is more soluble in cold than in hot water, an attempt was made to reduce the amount of lime by agitating in colder solutions. A mill temperature of 60° F. gave a 70 per cent extraction, whereas 120° gave 90 to 94 per cent extraction. The heat was increased to 140° F., but only decreased the time factor. The consumption of cyanide increased as the extraction increased. At 35 per cent the consumption was 1 lb. per ton of ore, at 90 per cent it was 3 lb. per ton of ore. A 1 to 1 dilution was found to be as good as a 4 to 1. The amount of lime required decreased as the silver content of the ore decreased. The gold extraction remained the same, 90 per cent, and whether 10 lb. or 130 lb. of lime per ton of ore was used.

"Difficulties were encountered in clarifying solutions and in precipitation following a six-day run on this ore. A white precipitate was deposited on the clarifier leaves, on the surface of the thickeners, in pipe-lines and on the zinc thread in the zinc boxes that were in use at that time. It was very harmful in the zinc boxes, coating the zinc so badly that precipitation ceased. Cleaning the boxes was the only method used to remove it. An analysis of this white precipitate gave:

Silica and insoluble matter	10.60%
Iron and aluminum oxide (Al_2O_3, Fe_2O_3)	10.76
Cadmium	trace less than 0.1
Zinc	trace less than 0.2%
Lime (CaO)	34.72
Magnesia (MgO)	trace less than 0.2
Loss on ignition (combined water and CO_2)	33.16

"These difficulties were eliminated by treating the ore in small lots at intervals of several days.

"The ore assayed 30 to 34 oz. silver and 0.10 oz. gold. With the increased cost of lime and heat the treatment was a commercial success."

Lime Burning a Lost Art

IF BUILDING a stone wall may be designated as an art, the burning of lime can lay equal claim to the title, declares Ferdinand Weingart in the *Tonindustrie Zeitung*. But it is an art that has been sadly neglected in the course of time. Lime production has become a factory process in which the only aim is to burn as much lime as possible in the shortest possible time. When lime production was looked upon as an art, the burner took pride in producing a superior material and the lime was tested and judged by its increase in volume in slacking. In the old literature of the trade, we find the rule laid down that lime in slacking must increase fourfold in volume in the pit, measured after the putty cracks.

Present-day conditions in the industry have completely changed this rule. Intermittent burning, in which the fires are extinguished when the process is finished, is practically unknown today. Nowadays, kilns are kept going from month to month without extinguishing the fires. If the object is to produce as much lime as possible, it can be attained only by calcining at excessive temperatures. The higher the temperature to which the stone is exposed, the more quickly the center of the stone is heated and reduced.

Lime users of today dread nothing more than the unslackable cores in their putty. They ascribe the presence of these cores to a niggardly use of fuel, and consider only the corresponding loss of quick lime; they do not seem capable of education along this line. The occurrence of cores is due mostly to the fact that some of the pieces of stone were too large. What takes place in the kiln is that the temperatures to which the stone is subjected penetrate gradually to the very center of each piece, more rapidly of course as the heat increases. If a piece of lime is cut through the center, rings or layers can be distinguished that have reached various degrees of heat while in the kiln.

Assuming that the maximum heat reached was 1,300 deg. C., rings are noticeable that were heated to 1,300, 1,200, 1,100, 1,000 and 900 deg. But of limes calcined at different temperatures, each has a different period of slacking. This view is confirmed by a study of the slacking process, which does not begin at the surface of the pieces but the very reverse; it begins at the center, which is the first to show activity and to swell. The outer shell is the last to disintegrate. It shows that slacking could be more quickly and better done if all layers were calcined at the same temperature.

To attain this result requires the skill of the experienced burner. When only high calcium stone is considered, there is less liability to produce this condition, but there are limestones which, calcined at 900 deg. C., must be overburdened when the temperature has been forced to 1000 deg.

Every lime plant should learn the peculiar properties of the stone utilized when burned at 900, 1,000, 1,100, 1,200 deg., etc. Then it will at once become evident that there is a great difference not only in the slacking qualities but also in the quantity of putty produced. These qualities will vary also with the content of carbonic acid gas, carbonates of lime and magnesia.

Accident Prevention

The Foreman as a Safety Factor

THE foreman is the determining factor in safety work. Without his whole-hearted support no safety campaign can accomplish what it should. He is the direct representative of the company, and workmen think of the company in the same light as the foreman appears to them. So it is absolutely useless for the company to lay out plans and make efforts to promote safety within the plant unless each foreman is going to do all he can to put them in effect.

Any good foreman knows that he must take a personal interest in his men. He must let them know that he is sincere in his interest in their welfare. It is the "regular fellow" who gets the whole-hearted support of his men, and with such support he can accomplish wonders. Slave-driving methods usually bring negative results.

The foreman must thoroughly understand the principles of safety himself before he can teach safety to his men. He must be able to put up convincing arguments for safety. He must show the men that their own safety is always first, and that production is dependent upon safety and increases in the same ratio that safety does.

In hiring new men, it is the foreman's duty to thoroughly acquaint each new man with his duties before he is allowed to begin work. It is no less the duty of the foreman to acquaint the new man with the danger spots about the plant, and the places where he must exercise caution. Safety instruction should start at the employment office and be continuous throughout each employe's connection with the plant. Keeping the "brotherly spirit" fostered in the minds and hearts of the workmen is what makes the 100 per cent safety organization.

Magazine Protection for Quarry Explosives

GENERAL legislative requirements for explosives magazines are fire-proofing, bullet-proofing and ventilation, writes Robert W. Jones in *Engineering and Mining Journal*. To these should be added moisture proofing and protection against theft. Metal, concrete or burned clay products are the ideal construction materials.

In quarry work, in which two magazines are usually used, one for main storage and a smaller one for daily supply, the choice of construction material for the smaller is somewhat restricted as the necessity for moving it frequently requires light weight.

The trouble with some magazines is that little attempt is paid to determining the proper distances between the location and habitations, railways and highways. Magazines may be of excellent construction, but the legal requirements may so reduce the capacity that they are of little value.

Mr. Jones' experience is that in building a magazine the owner should not start until all legal requirements are understood, and then if construction is attempted extra safety should not be sought by too heavy construction. A magazine may be perfectly safe and satisfy all the legal requirements, if of light weight, with a double wall and a sand-filled compartment, and with corrugated iron for walls. The construction cost will certainly be less than if it is of concrete or brick. Thus constructed, if a home or factory is erected within the legal distance, the magazine may be emptied of sand and easily moved. Such a magazine may be built to carry readily 2,000 lb. of explosives with comparative safety.

In ventilating magazines care must be taken that the method adopted shall not allow the entrance of sparks from field fires. A natural movement of air is all that is necessary, so that approximately the same condition of temperature will be maintained inside the magazine as that which will be found outside the structure. Moisture proofing depends upon the location. Have the ground around the magazine well drained, naturally, if possible. Moisture conditions, with the extreme heat of summer, have caused a great loss of explosives.

For protection against theft, common sense should be used. The writer has seen magazines with heavy, expensive locks opened with the greatest ease. Of what use is such a lock when the door frame is in such a condition that it is unnecessary to pick the lock? On the other hand, he has in mind two magazines that had been broken into, now apparently locked with common 25-cent locks, but actually locked by using a little ingenuity, so that for years no one has succeeded in entering.

Uncaged Beasts!

COULD you work with an uncaged lion near by? Couldn't you work faster and better if the lion were shut up in a strong cage? asks the W. S. Tyler Co., Cleveland, Ohio.

"Look about your plant—you may find some uncaged lions in the shape of exposed gears, belts, pulleys, and switches which are reducing the quality and quantity of the work done by your men. You would be repaid many times in more and better work if this exposed equipment were enclosed with safety guards."

It would be sheer advertising to tell you just how this company goes about it to avoid accidents, but the thought is here—and make the most of it.

Stop the Conveyor First

HE had worked eight years in a cement plant, and still he attempted to remove obstructions from a conveyor with a pinch bar while the conveyor was in motion, despite repeated warnings. Result: a torn hand and a loss of 22 days' work. Was the chance worth while?

Quarried from Life

By Liman Sandrock

From Quarry Kid to Congressman

Do ye pity the lad in the pit?
Ah, but he's the boy who is IT.
If he studies his job
An' digs hard, begob,
He'll rise to the highest—to wit:

FOR—not only in the Middle West, but from coast to coast and the Lakes to the Gulf do the folks know the name of Martin B. Madden, Illinois' representative in the national House and chairman of the appropriations committee.

But here's something many of them do not know: When he was a little tad, about 10 years old, Martin was the chief dispenser of the Volstead fluid, yclept water, in a quarry pit near the Reverend Williamson's super-city, Chicago. He would turn to at 7 in the morning, and many's the bucket of water he toted before the whistle blew at 6 o'clock that night. Husky? Well, he used to foot it three miles to work every blessed day, and back again at night.

And did he study? The Lord love you, he did that at the night school—while he was resting. By the time he was 16 he was the company daughtsman, and at 18, with his knowledge of engineering, he was the plant super and a thousand men followed his bidding. In 10 more years he was a partner.

What he has done for politics and what politics has done for him is common knowledge.

The moral of it all is Martin B.'s motto, "Study your job," and he has done this every blessed minute.

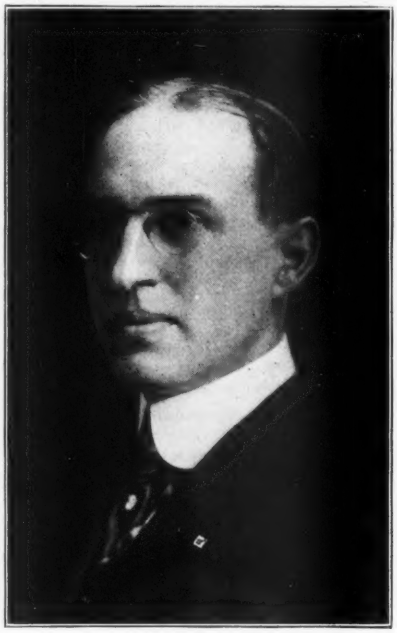
A Scholar and Gentleman

IT'S training that delivers the goods, whether we take the case of Jack Dempsey, Strangler Lewis, Babe Ruth—or J. D. Pierce, secretary of the Illinois Concrete Aggregate Association.

Punch, grip, ability to knock 'em for a home run have all these zippy, snappy sons, but J. D. is plus—plus the culture, the geniality, the gray matter of the American gentleman. And he's trained —oh, we'll say he's trained!

Brother Pierce back in the not so long ago was a business man, a manufacturer, and an organizer. His skill was first demonstrated in organizing the National Association of Bedding Manufacturers. Our own bedding experience is limited to the early times when we used to bed down old Dolly in our dad's barn in New England and picked feathers offen the chickens—meaning the Plymouth Rocks —to stuff our grandmother's bolster. But we do know that J. D. organized these bedding folks and that they stayed bedded good and proper.

He has also trafficked with traffic, for once he got in among the furniture makers and taught them to be traffic-wise to



J. D. Pierce, secretary of the Illinois Concrete Aggregate Association

the crool and insidious carrier who would charge the price of little Willie's crib to tote it from St. Paul to Minneapolis.

Then there's the Business Secretaries' Forum down here in Chicago. They got friend Pierce in the forum. You know what a forum is, brother—a tribunal, court, judicial body, an assembly? Sure, a body that discusses everything from Einstein's theory of relativity down to the dry and bitter 18th Amendment. Is it any wonder that J. D. should wear a lofty and pallid forehead (see illustration)? All the while training—that's the point.

Along in April, 1921, he brought all this fine mental equipment to the Illinois Concrete Aggregate Association—and laid it at their walkovers. Stepping *some!* (Later: He's been re-appointed.)

Some day when you're in the city buying your "excuse" for loitering about the cellar, step into the Chamber of Commerce building, climb to the quarter deck and there you'll find Cap'n Pierce at the hellum of the good ship *Association,* and he'll make you feel that he's been aching to see you since the last blue moon.

Even in his suburban home in Winnetka his training has dragged him from his fireside out into the local civic association, and on his off nights he's one of the city dads in the city council. We'll say that training delivers the goods—and J. D. is the goods.

They Said It!

A. J. BLAIR, Lake Shore Stone Co.: We have in our industry a greater variety of terms and discounts than Heinz has of pickles.

EDITOR BARROWS, National Sand and Gravel *Bulletin:* I positively deny being one of the five whose income exceeded $65,000,000 in 1919.

J. L. JANSEN, Wisconsin Mineral Aggregate Association: If a man has it in for you, he has 10 hr. to take it out of you; if he is the other way, he has 10 hr. a day to work to your advantage.

A. P. SANDLES (Shucks! you know who he is): Now, boys, 'twixt optimist and pessimist, the difference is droll: the optimist's the doughnut, the pessimist's the hole!

E. GUY SUTTON: The car, Michael! Let's go. I'm leaving Washington tonight. Logansport for me from now on. The car, Michael!

HARRY BRANDON, Ohio Marble Co.: It is possible for stone producers to create a demand for absolutely clean stone, absolutely properly sized, and elevate the business from "stone diggers" to *manufacturers* of stone.

BROTHER WYLIE, Iowa Freight Commissioner: Figures never lie, but liars can figure.

R. R. CUNNINGHAM, Newport News, Va.: We know from experience that concrete is as good as the material from which it is made.

GEORGE KILIAN, Dixie Portland Cement Co.: If you do not know correctly the actual cost of your product, you are not safe in competition and sooner or later will fill your allotted space in the industrial graveyard.

H. B. ALLEN, Eastern Stone Producers' Association: The layman's conception of the industry is that of a roadside quarry viewed from a railroad train—a mere hole in the ground, without the dignity or right to be placed in the category of other established industries.

BROWNELL MCGREW, Allis-Chalmers Co.: There is probably no branch of industrial engineering in which the individual judgment and common sense of the engineer are of greater importance than in the crushed-stone industry.

Editorial Comment

Publicity for the Little Fellow

What is publicity, and what is its value? There may be no connection between the announcement in December, 1919, at the height of high prices, that a well-known loop hotel in Chicago had made substantial reductions in the prices of rooms and of food, and the announcement 15 months later by the management of the same hotel that a new hotel, the largest in the world, with 3000 rooms and to cost $15,000,000, would soon be under construction. Then again there may be. It looks to be quite possible that the first announcement was a timely, well-planned, and far-sighted publicity move that will bring much business to the new hotel when it is completed.

Recently a manufacturer of portland cement submitted a bid to state engineers of two states which was substantially lower than other prices submitted. It was the only company at the time to secure the business of these two states, and this fact was heralded far and wide through news agencies to the very apparent advantage of the company. Because of delivery conditions, the price seems to have been very favorable to the company, but even had the low price resulted in loss to the company on the amount of cement involved, the loss would have been paid for many times over by the publicity gained.

These instances are from big business; few producers in any of the rock industries think of single investments in terms of $15,000,000, nor do they set prices on 100,000 tons of material in order to influence sales elsewhere at more favorable figures. But the principles are the same, whether the volume of business is $10,000 or $10,000,000. The little fellow who wants to progress must place himself favorably before his prospective customers; and the rock producer, with careful thought on the individual peculiarities of his situation, will see plenty of effective ways of accomplishing that purpose.

Your Business

The calendar tells us that Spring is here. Reports from everywhere—"operations have commenced again"—tell what the meaning of this season of budding, of new life, of joyful growth, is to the producer in the rock products industry. Plans that have been quietly forming bud forth at this time of Spring, new life pervades quarry and pit, joyfully the producer watches the volume of his output grow.

Will this Spring be like other Springs? The answer for the industry at large is that it is likely to be far better than other Springs. Road construction and construction of nearly every kind requiring sand, gravel, stone, cement, lime, gypsum and the other products of the earth, is scheduled in large volume.

For the individual, the answer depends a great deal on how he has prepared for the coming of Spring. Has he made the necessary repairs to his plant and equipment? Has he replaced the worn and broken parts with new? Has he obtained supplies of those pieces most subject to breakage, to minimize the delay when a break occurs? Has he provided adequate storage facilities which will smooth out the peaks and troughs of demand and maintain production in an even, uniform flow?

More important still, has he anticipated every contingency of the uncertain business he is in and laid plans carefully to meet even the most unexpected of conditions? Suppose the demand for his product doubles—will he increase his equipment, work longer hours, or add extra shifts, or accept only that business which he can satisfactorily handle with his present capacity? Individual conditions might make any of these steps the most profitable.

Suppose his orders require only half his capacity—will he increase his selling efforts, will he lower his prices, will he find new uses for his product which will open up new markets?

Has he during the winter planned new operating methods which will reduce the cost and increase the production? Are these the plans which are budding into new life in anticipation of joyful growth of business and profits as a result of their use?

Have you, Mr. Adams, done these and a hundred other things to assure to you and your company the most prosperous year possible under existing conditions, general and local? If you haven't it still is not too late, before production reaches its highest point, to do some of them and atone partially for your failure to do them previously.

Conditions of general business are beyond your control, but the preparations of your own business for a maximum of service and usefulness is preeminently "your business," and you owe it not only to yourself and your business associates, but to your customers, your community, and the country to prepare your business for the most effective operation possible.

An Indicator of Business

There is no better business indicator for the agricultural limestone industry than the activity of mail-order houses, it has been stated. When the farmer has more money, part of it goes for fertilizer and part for the purchase of farm, household, and personal comforts and necessities from the mail-order house. Watch the sales of Sears, Roebuck and Company in your territory increase, and you'll know you have a market for more agricultural limestone.

The Rock Products Market

Wholesale Prices of Crushed Stone

Prices given are per ton, F. O. B., at producing plant or nearest shipping point

Crushed Limestone

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
EASTERN:						
Blakeslee, N. Y.	1.00	1.25	1.25	1.25	1.25	....
Buffalo, N. Y.	1.50 per net ton all sizes—Winter prices from stock					
Burlington, Vt.	1.00	....	2.50	2.00	2.00	....
Chaumont, N. Y.	1.00	....	1.75	1.50	1.50	1.50
Cobleskill, N. Y.	1.25	1.25	1.25	1.25	1.25	....
Coldwater, N. Y.	1.50 per net ton all sizes; fluxing stone 1.80 per ton					
Eastern Penna.	1.00	1.50	1.50	1.50	1.50	1.50
Munns, N. Y.	1.00	1.25	1.25	1.25	1.25	1.25
Western New York	1.00	1.25	1.25	1.25	1.25	1.25
CENTRAL						
Alden, Ia.	.80@1.00	.80@1.00	1.50	1.45	....	....
Alton, Ill.	2.00	....	1.50	1.35	1.35	....
Buffalo, Iowa	1.00	1.50	1.40	1.30	1.35	1.35
Chicago, Ill.	1.20	1.60	1.20	1.20	1.20	1.20
Dundas, Ont.	1.00	1.35	1.35	1.25	1.10	1.10
Greencastle, Ind.	1.00	1.15	1.05	1.00	1.00	1.00
Illinois, Southern	1.75	1.60	1.50	1.50	1.40	....
Kansas City, Mo.	.60	1.60	1.60	1.60	1.60	1.60
Kokomo, Ind.	1.10	1.25	1.25	1.10	1.10	1.10
Krause or Columbia, Ill.	1.35	1.20	1.20	1.10	1.10	1.10
Lannon, Wis.	.90	1.00	1.00	1.00	1.00	1.00
Marblehead and Brillion, Wis.	1.10	....	1.20	1.10	1.10	....
Montreal, Canada	.85	1.20	1.10	1.05	1.00	....
Montrose, Ia.	....	1.50	1.60	1.55	1.50	....
River Rouge, Mich.	1.15	1.15	1.15	1.15	1.15	1.10
Sheboygan, Wis.	1.00	1.10	1.10	1.10	1.00	....
Southern Illinois	1.35	1.35	1.35	1.25	1.25	....
Stolle, Ill. (I. C. R. R.)	1.30	....	1.25	1.35	....	....
Stone City, Iowa	.75	....	1.40	1.30	1.25	....
Toledo, Ohio	1.60	1.70	1.70	1.70	1.60	1.60
Toronto, Canada	1.90	2.25	2.25	2.25	2.00	2.00
		Prices include 90c freight				
Valmeyer, Ill.	1.60	1.30	1.30	1.30	1.30	1.30
Waukesha, Wis.	all sizes 1.10 per ton					
SOUTHERN:						
Alderson, W. Va.	1.10	1.35	1.65	1.35	1.35	....
Bromide, Okla.	1.50	....	....	1.50	1.50	....
Cartersville, Ga.	....	2.00	2.00	1.40	1.40	1.40
Chickamauga, Tenn.	.80@1.00	.80@1.00	....	.75@1.00	.65@1.00	.60@ .80
Dallas, Texas	1.00	1.00	1.00	1.00	1.00	1.00
Ft. Springs, W. Va.	1.20	1.50	1.75	1.60	1.45	1.30
El Paso, Tex.	1.00	1.00	1.00	1.00	1.00	....
Gainesville, Ga.	1.00	1.25	1.25	1.25	1.25	1.25
Garnet and Tulsa, Okla.	.50	1.60	1.60	1.45	1.45	....
Ladds, Ga.	2.00	2.00	2.00	1.50	1.50	1.50
Morris Spur (near Dallas) Tex.	1.10	1.25	1.25	1.25	1.25	1.25
Portland, Ga.	.60@1.00	(All other sizes 1.00@1.25)				
Shephard, Tenn.	1.00@1.25	1.00@1.25	1.00@1.25	.75@1.00	.75@1.00	....
WESTERN:						
Atchison, Kans.	.50	2.10	2.10	2.10	2.10	2.10
Blue Springs and Wymore, Neb.	.20	1.65	1.65	1.55	1.45	1.40
Cape Girardeau, Mo.	1.50	....	1.50	1.50	1.25	....
Kansas City, Mo.	1.00	1.80	1.80	1.80	1.80	1.80

Crushed Trap Rock

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Bernardsville, N. J.	2.00	2.20	2.00	1.80	1.50	....
Branford, Conn.	.60	1.50	1.25	1.15	1.00	....
Bound Brook, N. J.	2.30	2.50	2.20	1.90	....	....
Dresser Jct., Wis.	1.25	2.25	2.25	1.75	1.50	1.50
Duluth, Minn.	.90@1.00	2.25	1.90@2.00	1.40@1.50	1.30@1.40	1.30@1.40
E. Summit, N. J.	2.30	2.60	2.40	2.00	2.35	....
Eastern Mass.	.60	1.85	1.60	1.50	1.50	1.50
Eastern New York	.80	1.60	1.60	1.50	1.40	1.40
Eastern Penna.	1.00	1.85	1.75	1.55	1.45	1.45
New Britain, Middlefield, Rocky Hill, Meriden, Conn.	.60@ .80	1.60@1.75	1.50	1.25	1.10	....
Oakland, Calif.	1.75	1.75	1.75	1.75	1.50	1.50
Richmond, Calif.	.50*		1.75*	1.50*	1.50*	
San Diego, Calif.	.50@ .70	1.45@1.75	1.40@1.70	1.30@1.60	1.25@1.55	1.25@1.55
Springfield, N. J.	1.80	2.00	1.85	1.75	1.60	1.60
Westfield, Mass.	.60	1.35	1.30	1.20	1.10	....

Miscellaneous Crushed Stone

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Alexandria Bay, N. Y.	1.60	....	1.30	1.50	1.20	....
Dell Rapids, S. D.—Granite	.75	1.85	1.75	1.70	1.70	....
Dundas, Ont.—Flint	1.00	1.50	1.50	1.50	1.25	1.20
Eastern Penna.—Sandstone	.85	1.55	1.55	1.40	1.40	1.40
Eastern Penna.—Quartzite	.90	1.20	1.20	1.20	1.20	1.20
Holton, Ga.—Granite	.40	....	2.50	2.25	2.25	2.00
Lohrville, Wis.—Cr. Granite	1.35	1.40	1.30	....	1.20	....
Los Angeles, Cal.—Granite	....	1.25@1.50	1.15@1.40	1.15@1.40	....	....
Macon, Ga.—Granite	.50	....	2.50	2.25	2.00	1.25@1.90
Middlebrook, Mo.—Granite	3.00@3.75	....	2.00@2.35	2.20@2.75	....	1.25@1.75
Red Granite, Wis.	1.35	1.40	1.30	1.50	1.20	....
Sioux Falls, S. D.—Granite	.75	1.85	1.75	1.70	1.70	....
Stockbridge, Ga.—Granite	.50	2.00	1.90	1.75	1.75	....
Utley, Wis.—Red Granite	1.35	1.40	1.30	....	1.20	....

*Cubic yard. †Agrl. lime. ||R. R. ballast. §Flux. ‡Rip-rap. a 3-inch and less.

Agricultural Limestone

EASTERN:

Chaumont, N. Y. — Analysis, 95% $CaCO_3$, 1.14% $MgCO_3$ — Thru 100 mesh; sacks, 4.00; bulk	2.50
Grove City, Pa. — Analysis, 94.89% $CaCO_3$, 1.50% $MgCO_3$—100% thru 20 mesh, 60% thru 100 mesh, 40% thru 200 mesh; in 80 lb. paper sacks, 4.50; bulk	3.00
Hillsville, Pa. — Analysis, 96.25% $CaCO_3$—75% thru 100 mesh; 85% thru 50 mesh; sacks, 4.50; bulk	3.00
Jamesville, N. Y. — Analysis, 89.25% $CaCO_3$, 5.25% $MgCO_3$; sacks, 4.00; bulk	2.50
New Castle, Pa.—89% $CaCO_3$, 1.4% $MgCO_3$—75% thru 100 mesh, 84% thru 50 mesh, 100% thru 10 mesh; sacks, 4.75; bulk	3.00
Osborne, Pa.—45% thru 200 mesh, 60% 100 mesh, 100% thru 20 mesh; 4.50 sacks; bulk	3.00
Texas, Md.—Analysis, 58.02% $CaCO_3$, 37.3% $MgCO_3$—50% thru 50 mesh; bags, 4.25; bulk	2.50
West Stockbridge, Mass., Danbury, Conn., North Pownal, Vt.—Analysis, 90% $CaCO_3$—50% thru 100 mesh; paper bags, 5.00—cloth, 5.25; bulk	3.50
Williamsport, Pa. — Analysis, 88-90% $CaCO_3$, 2-4% $MgCO_3$—50% thru 50 mesh; paper, 4.75; bulk	3.75

CENTRAL:

Alton, Ill. — Analysis, 96% $CaCO_3$, 0.3% $MgCO_3$—90% thru 100 mesh	7.75
Bedford, Ind. — Analysis, 98.5% $CaCO_3$, .5% $MgCO_3$—90% thru 10 mesh	1.60@2.00
Belleville, Ont. — Analysis, 90.9% $CaCO_3$, 1.15% $MgCO_3$—45% to 50% thru 100 mesh, 61% to 70% thru 50 mesh; bulk	2.50
Bellevue, Ohio — Analysis, 61.56% $CaCO_3$, 36.24% $MgCO_3$; ¼ in. to dust, about 20% thru 100 mesh	1.25
Bettendorf, Ia., and Moline, Ill.—50% thru 100 mesh, 50% thru 4 mesh	1.65
Buffalo, Ia.—90% thru 4 mesh	1.00
Cape Girardeau, Mo.—Analysis, 93% $CaCO_3$, 3.3% $MgCO_2$ (90% thru 50 mesh, 2.00), 50% thru 4 mesh	1.50
Chicago, Ill.—Analysis, 53.63% $CaCO_3$, 37.51% $MgCO_3$—90% thru 4 mesh	1.00
Columbia, Ill., near East St. Louis—⅛-in. down	1.25@1.80
Detroit, Mich.—Analysis, 88% $CaCO_3$, 7% $MgCO_3$—75% thru 200 mesh, 2.50@4.75—60% thru 100 mesh	1.80@3.80
Elmhurst, Ill. — Analysis, 35.73% $CaCO_3$, 20.69% $MgCO_3$—50% thru 50 mesh	1.25
Greencastle, Ind. — Analysis, 98% $CaCO_3$—50% thru 50 mesh	2.00
Kansas City, Mo.—50% thru 100 mesh	1.60
Krause and Columbia, Ill.—Analysis, 90% $CaCO_3$, 90% thru 4 mesh	1.35
Lannon, Wis.—Analysis, 54% $CaCO_3$, 44% $MgCO_3$—90% thru 50 mesh	2.00
Marblehead, O.—Analysis, 33.42% $CaCO_3$, 4.2% $MgCO_3$—52.4% thru 100 mesh, 59% thru 50 mesh, 100% thru 10 mesh; sacks, 4.50; bulk	3.00
Limestone screenings; bulk	1.50
Milltown, Ind. — Analysis, 93.10% $CaCO_3$, 3.20% $MgCO_3$—33.6% thru 100 mesh, 40% thru 50 mesh	1.35@1.50
Mitchell, Ind. — Analysis, 97.65% $CaCO_3$, 1.76% $MgCO_3$ — 60% thru 100 mesh, all thru 10 mesh	1.25
Montrose, Ia.—50% thru 100 mesh	1.35
Narlo, Ohio—Analysis 56% $CaCO_3$, 43% $MgCO_3$, limestone screenings, 37% thru 100 mesh; 55% thru 50 mesh; 100% thru 4 mesh	1.50@2.00
Ohio (different points), 20% thru 100 mesh; bulk	1.25@1.50
Piqua, O.—100% thru 10; 90% thru 50; 70% thru 100	3.25@5.00
99% thru 10; 55% thru 50; 40% thru 100	1.75@2.00
River Rouge, Mich. — Analysis, 54% $CaCO_3$, 40% $MgCO_3$; bulk	.80@1.40
Stolle, Ill., near East St. Louis on I. C. R. R.—Thru ⅛-in. mesh	1.30
Stone City, Ia.—Analysis, 98% $CaCO_3$, 50% thru 30 mesh	.75

(Continued on next page)

Agricultural Limestone

(Continued from preceding page.)

Toledo, Ohio—¼-in. to dust, 20% thru 100 mesh	1.50
Waukesha, Wis.—No. 1 kiln dried	2.00
No. 2 Natural	1.75
Whitehill, Ill.—Analysis, 96.12% $CaCO_3$, 2.5% $MgCO_3$—90% thru 100 mesh	5.00
90% thru 50 mesh	1.35
Yellow Springs, Ohio—Aanlysis 96.08% $CaCO_3$, 63% $MgCO_3$, 32% thru 100 mesh; 95.57%, sacked, 6.00; bulk	4.25
SOUTHERN:	
Alderson, W. Va.—90% thru 50 mesh	1.50
Barber, Va.—Analysis, 92 to 98% $CaCO_3$—Bags, 6.50; bulk	4.50
Blowers, Fla.—Analysis, 98% combined carbonates—75% thru 200 mesh	4.75
Cape Girardeau, Mo.—Analysis, 93% $CaCO_3$, 3.5% $MgCO_3$—50% thru 100 mesh	2.00
90% thru 4 mesh	1.50
Cartersville, Ga.—Analysis, all thru 10 mesh	1.75@2.00
Claremont, Va.—Analysis, 92% $CaCO_3$, 2% $MgCO_3$—90% thru 100 mesh, 4.00; 50% thru 100 mesh, 3.00; 90% thru 50 mesh, 3.00; 50% thru 50 mesh, 2.75; 90% thru 4 mesh, 2.75; 50% thru 4 mesh	2.75
Ft. Springs, W. Va.—50% thru 100 mesh	3.00
Hot Springs, N. C.—Agricultural limestone; sacks, 4.25; bulk	3.00
Knoxville, Tenn.—Pulverized	2.50
90% thru 100 mesh	2.00
90% thru 50 mesh	1.50
Ladds, Ga.—90% thru 50 mesh	2.00
Linnville Falls, N. C.—Analysis, 53% $CaCO_3$; 42% $MgCO_3$—50% thru 100 mesh; sacks, 4.50; bulk	3.00
Mountville, Va.—Analysis, 76.60% $CaCO_3$, 22.83% $MgCO_3$—X thru 20 mesh; sacks	5.00
WESTERN:	
Colton, Calif.—Analysis, 90.95% $CaCO_3$, 1-3% $MgCO_3$—all thru 14 mesh—bulk	4.00
Garnett, Okla.—Analysis, 86% $CaCO_3$, 50% thru 4 mesh	.50
Kansas City, Mo., Corrigan Sid'g—50% thru 100 mesh; bulk	1.80
Terminous, Calif.—Analysis, 97.3% $CaCO_3$, .04% $MgCO_3$—65% thru 200 mesh, 90% thru 100 mesh, 95% thru 80 mesh, 100% thru 50 mesh; sacks, 5.00; bulk	4.50
Tulsa, Okla.—90% thru 4 mesh	.50

Miscellaneous Sands

Silica sand is quoted washed, dried and screened unless otherwise stated.

GLASS SAND:	
Baltimore, Md.	2.25@2.75
Berkley Springs, W. Va.	2.00@2.25
Cedarville and South Vineland, N. J.—Damp, 1.75; dry	2.25
Cheshire, Mass.	5.00@7.00
Hancock, Md.—Damp	2.50@3.50
Klondike and Pacific, Mo.	2.00@2.50
Mapleton, Pa.	2.25@2.50
Massillon, Ohio	3.00
Millington, Ill.	1.75
Mineral Ridge, O.—Dry	2.50
Green	2.25
Montoursville, Pa.—Green, washed	2.00
Oregon, Ill.—Glass sand	.75
Pittsburgh, Pa.—Dry, 4.00; damp	3.00
Rockwood, Mich.	2.75
Round Top, Md.—(washed-screened)	1.25
St. Mary's, Pa.—Unwashed	2.25
Thayers, Pa.	2.50
Utica, Ill.	1.25@1.75
Zanesville, Ohio	2.00@2.50
FOUNDRY SAND:	
Albany, N. Y.—Sand blast	4.00
Molding fine, coarse and brass	2.25@2.50
Allentown, Pa.—Core and molding fine	1.50@1.75
Arenzville, Ill.—Molding fine	1.40@1.60
Beach City, O.—Core, washed and screened	2.00@2.50
Furnace lining	2.50@3.00
Molding fine and coarse	2.25@2.50
Cleveland, O.—Molding coarse	1.50@2.00
Brass molding	1.50@2.00
Molding fine	1.50@2.25
Core	1.25@1.50
Columbus, O.—Core	.30@1.25
Sand blast	4.50@5.00
Furnace Lining	2.00
Molding fine	2.00@2.75
Molding coarse	1.75@2.50

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Wholesale Prices of Sand and Gravel

Prices given are per ton, F. O. B., at producing plant or nearest shipping point

Washed Sand and Gravel

City or shipping point	Fine Sand, 1/10 inch down	Sand, ¼ inch and less	Gravel, ½ inch and less	Gravel, 1 inch and less	Gravel, 1½ inch and less	Gravel, 2 inch and less
EASTERN:						
Ambridge and So. Heights, Pa.	....	1.15	1.15	1.15	.70	.70
Buffalo, N. Y.	1.10	.95	.85	.85	.85	.85
Erie, Pa.	....	1.00	....	1.15	....	1.25
Farmingdale, N. J.	.48	.48	1.30	1.30	1.20	....
Hartford, Conn.	.90	....	1.25	1.15	1.15	1.15
Leeds Junction, Me.	....	.50	1.75	1.50	1.35	1.25
Ludlow, Mass.	.75*	.75*	1.70	....	1.50*	1.50*
Philadelphia, Pa.	.75	.75	....	1.40	1.25	....
Pittsburgh, Pa.	1.15	1.15	1.15	1.15	.70	.70
Portland, Maine	....	.50	1.75	....	1.35	1.35
Texas, Md.	....	1.00	....	Pure white sand, 1.50		
Washington, D. C.	.60@ .75	.60@ .75	1.60@2.00	1.40	1.20	1.20
CENTRAL:						
Alton, Ill.	....	.85	....	....	....	....
Anson, Wis.	.40	.40	....	....	....	.90
Attica and Covington, Ind.	.90	.90	.90	1.00	1.00	1.00
Barton, Wis.	....	.60	.70	.70	.70	.70
Beloit, Wis.	....	.50	....	....	.50	....
Chicago, Ill.	....	1.75@2.23	1.75@2.43	....	....	....
Cincinnati, Ohio	.70	.65	.90	.90	.90	.90
Columbus, Ohio	....	.75@1.25	.75@1.25	.75@1.25	.75@1.25	.75@1.25
Des Moines, Ia.	....	.40@ .60	.40	1.30	1.50	1.50
Detroit, Mich.	.65	.65	.95	.95	.95	.95
Earlestead (Flint), Mich.	.70		60-40 sieves, .85; Pebbles, .95			
Eau Claire, Wis.	.40	....	1.25	....	.90	....
Elkhart Lake, Wis.	.70	.58	.90	.90	.72	.72
Ft. Dodge, Ia.	....	1.22	....	2.17	....	....
Grand Rapids, Mich.	....	.50	....	.85	.75	.75
Greenville, Mechanicsburg, O.	.60	.50	.50	.50	.60	.60
Hamilton, Ohio	....	.85	....	....	.85	....
Hawarden, Ia.	....	.50	....	....	1.60	....
Hersey, Mich.	.50	.50	....	....	.80	.70
Indianapolis, Ind.	.60	.60	....	1.50	.75@1.00	.75@1.00
Janesville, Wis.	....	.65@ .75	....	....	.65@ .75	....
Le Mars, and Doon, Ia.	....	.90	....	1.80	....	....
Libertyville, Ill.	....	.70	....	.70	.70	....
Mankato, Minn.	.50	.40	.75@1.25	.75@1.25	.75@1.25	.75@1.25
Mason City, Ia.	.65	.55	1.55	1.60	1.60	1.55
Milwaukee, Wis.	1.15	1.15	1.25	1.25	1.25	1.25
Minneapolis, Minn.	.35	.35	1.50	1.25	1.25	1.25
Moline, Ill.	.60@1.00	.60@1.00	1.60	1.60	1.60	1.60
Riton, Wis.	....	.60	....	.70	.70	.70
St. Louis, Mo., f. o. b. cars	1.10	1.35	1.50	1.30	....	1.25
St. Louis, Mo., delivered on job	2.05	2.20	2.35	2.15	....	2.10
Summit Grove, Clinton, Ind.	.65@ .75	.65@ .75	.65	.75	.75	.75
Terre Haute, Ind.	.75	.75	.75	.75	.75	.75
Waukesha, Wis.	.60		All other sizes, .70 per ton			
Winona, Minn.	.50	.50	1.50	1.25	1.25	1.25
SOUTHERN:						
Alexandria, La.	.60@ .80	.50@ .75	....	....	.85@1.50	1.20@1.50
Birmingham, Ala.	1.48		all gravel—1.88			
Charleston, W. Va.		(Sand, 1.40@1.50; gravel, 1.50				
Estelle Springs, Tenn.	1.15	1.00	1.00	1.00	.85	.65
Ft. Worth, Tex.	....	2.00	....	2.00	....	2.06
Jackson's Lake, Ala.	.50@ .60	.50@ .60	.40@1.00	1.00	.50@1.00	.50@1.00
Knoxville, Tenn.	1.00@1.15	1.00@1.15	....	2.12	1.92	1.74
Lake Weir, Fla.	....	.75	....	....	....	....
Macon, Ga.	....	.50@ .75	....	....	....	....
Memphis, Tenn.	1.12	1.12	....	....	....	1.95
N. Martinsville, W. Va.	....	1.00	....	1.20	....	.80
New Orleans, La.	....	.50	....	....	1.00	....
Pine Bluff, Ark.	1.25	.80	Washed gravel, all sizes, 1.75			
Roseland, La.	.25	....	.85	....	....	....
WESTERN:						
Grand Rapids, Wyo.	.50	.50	.85	.85	.80	.80
Jedburg, Mo.	.70	1.20	.95	.75	.75	.70
Kansas City, Mo.	(Kaw River sand, car lots, .75 per ton, Missouri River, .85)					
Los Angeles, Calif.	....	.75	1.25	1.25	1.15	1.15
Niles, Calif.	1.00	1.00	1.40	1.00	1.00	1.00
Pueblo, Colo.	1.10*	.90*	....	....	1.50*	....
San Diego, Calif.	.80@1.00	.80@1.00	1.30@1.60	1.25@1.55	1.15@1.45	1.10@1.40
San Francisco, Calif.	....	1.00	1.00@1.20	.85@1.00	.85@1.00	.85@1.00
Seattle, Wash.	1.50*	1.50*	2.00*	1.50*	....	1.50*
Yutan, Neb.	.40		Bank run .40			

Bank Run Sand and Gravel

City or shipping point	Fine Sand, 1/10 inch down	Sand, ¼ inch and less	Gravel, ½ inch and less	Gravel, 1 inch and less	Gravel, 1½ inch and less	Gravel, 2 inch and less
Attica, Covington, Silverwood, Ind., and Palestine, Ill.	.75	.75	.75	.75	.75	.75
Boonville, N. Y.	.60@ .80	....	.55@ .75	....	....	1.00
Cape Girardeau, Mo.			River sand, 1.00 per yd.			
Cherokee, Ia.			.80 per ton—1.20 washed			
Dudley, Ky. (Crushed Sand)	....	1.05	....	1.00	....	....
East Hartford, Conn.			.65 per cu. yd.			
Elkhart Lake, Wis.			Washed gravel .66			
Estelle Springs, Tenn.	....	....	....	....	....	.85
Fishers, N. Y.	.50@ .60	....	....	.50@ .60	....	....
Hamilton, O.			.45 per cu. yd. in pit			
Hartford, Conn.	....	1.00*	....	....	....	....
Hersey, Mich.	.30	....	....	.50	.50	....
Indianapolis, Ind.		Mixed gravel for concrete work, .65				
Lindsay, Tex.	1.45	....	....	....	.60	....
Janesville, Wis.	....	.65	....	....	.65@ .75	....
Oxford, Mich.	....	....	....	.65	.65	....
Pine Bluff, Ark.			Road gravel .50			
Rochester, N. Y.	.60@ .75	.60@ .75	....	....	.50@ .65	.50@ .65
Roseland, La.	....	.75	....	....	....	....
Saginaw, Mich., f. o. b. cars	....	.75	1.30	1.30	1.30	1.30
St. Louis, Mo.		60% gravel, 40% sand, 1.40				
Summit Grove, Ind.	.50	.50	.50	.50	.50	.50
Waco, Texas	....	.80	....	1.50	....	1.30
Winona, Minn.		....	.70	.70	.70	.70
York, Pa.	....	.95@1.20	(crushed rock sand)			

*Cubic yard. B Bank. L Lake. || Ballast.

Crushed Slag

City or shipping point	Roofing	¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
EASTERN:							
Buffalo, N. Y.	2.35	1.25	1.25	1.25	1.25	1.25	1.25
E. Canaan, Conn.	4.00	1.00	2.50	1.25	1.25	1.25	1.25
Eastern Pennsylvania and Northern New Jersey	2.00	1.20	1.50	1.20	1.20	1.20	1.20
Easton, Pa.	2.00	.80	1.25	.90	.90	.90	.90
Erie, Pa.	2.35	1.25	1.25	1.25	1.25	1.25	1.25
Emporium, Pa.	2.35	1.25	1.25	1.25	1.25	1.25	1.25
Sharpsville and West Middlesex, Pa.	2.00	1.30	1.70	1.30	1.30	1.30	1.30
Western Pennsylvania	2.00	1.25	1.50	1.25	1.25	1.25	1.25
CENTRAL:							
Chicago, Ill.	All sizes, $1.50, F. O. B. Chicago						
Detroit, Mich.	All sizes, 1.65, F. O. B. Detroit						
Ironton, O.	2.05	Other grades 1.45					
Stuebenville, O.	2.00	1.40	1.70	1.40	1.40	1.40	1.40
Toledo, O.	1.92	1.67	1.77	1.77	1.77	1.67	1.67
Youngstown, Dover, Hubbard, Leetonia, Struthers, O.	2.00	1.25	1.50	1.25	1.25	1.25	1.25
	(Any delivery in city except team track deliveries)						
Steubenville, Lowellville and Canton, O.	2.00	1.35	1.60	1.35	1.35	1.35	1.35
SOUTHERN:							
Birmingham, Ala.	2.05	.80	1.25	1.15	1.10	.95	.85
Ensley, Ala.	2.05	.80	1.25	1.15	1.10	.95	.85
Longdale, Goshen, Glen Wilton & Low Moor, Roanoke, Va.	2.50	1.00	1.60	1.25	1.25	1.15	1.05

Lime Products (Carload Prices Per Ton F.O.B. Shipping Point)

	Finishing Hydrate	Masons' Hydrate	Agricultural Hydrate	Chemical Hydrate	Ground Burnt Lime Blk.	Ground Burnt Lime Bags	Lump Lime Blk.	Lump Lime Bbl.
EASTERN:								
Adams, Mass.			7.00					3.50
Bellefonte, Pa.			8.00	9.00	8.00		7.50	
Berkley, R. I.			14.00					2.50
Buffalo, N. Y.		11.00	11.00	11.00			9.50	2.00*
Chaumont, N. Y.					2.50	4.00		
Lime Ridge, Pa.							5.00	
Paxtang and LeMoyne, Pa.					5.00		4.75@5.00	
Union Bridge, Md.			13.00		5.50			
West Rutland, Vt.	13.50	12.25	7.50@12.25	14.00			11.00	3.50
West Stockbridge, Mass.			15.00					
Williams and Blue Bell, Pa.			11.25					
Williamsport, Pa.			10.00			10.00	6.00	
York, Pa. (dealers' prices)		9.50	9.50@10.50	9.50@10.50			7.00	
CENTRAL:								
Delaware, Ohio	10.50	9.00	8.50	9.50			8.00	1.40
Geneo, Ohio	10.50§							
Gibsonburg, Ohio	10.50§	8.50	8.50		7.25	9.25		
Huntington, Ind.	10.50	9.00	8.50				8.00	1.70*
Knowles and Valders, Wis.			12.50		5.00	9.00		
Marblehead, Ohio	10.50	9.00	7.75	11.00	6.75		8.00	1.50*
Mitchell, Ind.		11.00	11.00	11.00	9.50		8.50	1.45
Sheboygan, Wis.					5.50	8.50		
White Rock, Ohio	10.50				2.25	9.25		
Woodville, O. (dlrs.' price)	10.50a	9.00a	7.25a	10.00a	7.25		8.00	1.50
SOUTHERN:								
El Paso, Tex.							12.50	
Karo, Va.							7.00	1.30
Knoxville, Tenn.		9.50@11.00	9.50@11.00				7.50	1.30
Ocala and Zuber, Fla.	12.00	12.00	11.00			11.50		1.50
Sherwood, Tenn	11.00	9.50			7.50		7.50	
Staunton, Va.					8.00		9.50b	1.60
WESTERN:								
Colton, Calif.			15.00				19.70	
Kirtland, N. Mex.					12.50	15.00		
San Francisco, Calif.	22.00	21.00	15.00	22.00			16.00	2.15*

‡100-lb. sacks; *180-lb. net, price per barrel; †180-lb. net, non-returnable metal barrel; §Paper sacks. (a) 50-lb. paper bags; terms, 30 days net; 25c per ton or 5c per bbl. discount for cash in 10 days from date of invoice. (b) Burlap bags. (c) 200-lb. bbl.

Miscellaneous Sands

(Continued from preceding page)

Stone sawing	1.50
Traction	1.00
Brass molding	2.75
Delaware, N. J.—Molding fine	2.00
Molding coarse	1.90
Brass Molding	2.15
Dresden, O.—Molding coarse	1.50@1.75
Brass molding	1.75
Dunbar, Pa.—Traction, damp	2:00
Dundee, O.—Glass, core, sand blast, traction	2.50
Molding fine, brass molding (plus 75c for winter loading)	2.00
Molding coarse (plus 75c for winter loading)	1.75
Falls Creek, Pa.—Glass sand	2.50
Furnace lining, traction and molding coarse and fine, and core	2.00
Sand blast	3.50
Eau Claire, Wis.—Core	.75@1.25
Sand blast	3.25@4.25
Traction sand	.50
Franklin, Pa., and Utica, Pa.—Traction	1.75@2.00
Core	1.25@2.00
Molding coarse	2.00
Furnace lining	2.50
Greenville, Ill.—Molding coarse	1.50@1.70
Joliet, Ill.—Milled, dried and screened No. 2 coarse molding sand and open hearth loam and looting clay	.75@1.25
Kansas City, Mo.—Missouri River core	.80
Kasota, Minn. — Molding coarse and fine, stone sawing (pit run)	**1.75**
Klondike, Pacific and Gray Summit, Mo.—Molding fine and core	1.75@2.25
Mapleton, Pa.—Glass sand, core, furnace lining, molding fine and coarse; dry, 2.50; damp	2.00
Massillon, O. — Traction, molding fine and coarse, furnace lining	2.25
Michigan City, Ind.—Core, traction	.30@ .40
Mineral Ridge, Ohio — Core, furnace lining, molding fine and coarse, roofing, sand blast, stone sawing and traction (green)	**2.00**
Montoursville, Pa.—Core	1.25@1.40
Traction	1.00@1.25
Brass molding	1.50
New Lexington, O.—Molding fine	2.75
Molding coarse	2.50
Oregon, Ill.—Core, furnace lining, molding fine and coarse, traction	.75
Ottawa, Ill. — Core, molding coarse (crude silica sand)	.75@1.00
Ottawa, Minn.—Core	1.00@1.50
Glass, molding coarse, stone sawing (all crude silica)	1.00@1.50
Pelzer, S. C.—Glass sand (carload lots only)	.70
Rockwood, Mich.—Core, damp	2.50
Roofing	2.75
Sand blast	3.75

Miscellaneous Sands

(Continued)

Round Top, Md.—Glass sand	1.75@2.00
Core, furnace lining	1.45
Traction	1.60
(All per 2000 lbs.)	
San Francisco, Cal.—Glass and roofing	3.00@3.50
Core, molding fine and brass	2.30@2.60
Furnace lining and molding coarse	3.60@4.25
Coarse core sand	3.60@4.25
Sand blast	3.75
Stone sawing and traction	2.30
Thayer, Pa.—Traction & stone sawing	2.00
Furnace lining, m'ld'g fine and coarse	1.25
Core	2.00
Utica, Ill.—Core	.85@1.10
Glass sand	1.25@1.50
Furnace lining	.85@2.00
Molding fine and coarse	.85@1.25
Roofing sand	1.25
Sand blast	2.25@3.00
Stone sawing	1.25@2.25
Traction and brass molding	1.25
Utica, Pa.—Core	**1.25@2.25**
Molding fine and coarse, traction, brass molding	**2.00**
Warwick, O. — Core, furnace lining, molding fine and coarse (damp, 1.75) dry	2.00
Traction (dry)	2.00
Zanesville, O.—Core, furnace lining	2.25
Molding fine, traction, brass molding	*2.00
Molding coarse	*1.75

*Plus 75c per ton.

Talc

Prices given are per ton f. o. b. (in carload lots only) producing plant, or nearest shipping point.

Baltimore, Md.—Crude Talc	**3.50**
Ground talc (20-50 mesh), bags	**10.00**
Cubes	**50.00**
Blanks, per lb.	**.07**
Chatsworth, Ga.—Crude talc	**8.00@10.00**
Ground talc (150-200 mesh), bags	**12.50**
Pencils and steel workers' crayons, per gross	**1.50@ 2.00**
Chester, Vt. — Ground talc (150-200 mesh), including bags	7.50@10.00
Emeryville, N. Y.—200-300 mesh; bags	14.75
Glendale, Calif. — Ground talc (150-200-mesh	16.00@30.00
(Bags extra)	
Ground Talc (50-300 mesh)	13.50@15.50
Gordonsburg, Tenn.—B.P.L. 68%@72%	4.50@6.00
200 mesh)	13.50@14.50
Hailesboro, N. Y.—Ground talc (150-250 mesh), bags	18.00
Henry, Va.—Crude talc (lump mine run), per 2000-lb. ton	2.75@3.50
Ground talc (20-50 mesh), bags, 7.75; (150-200 mesh) bags	7.75@11.00
Johnson, Vt.—Ground talc (20-50 mesh), bulk 7.50 (150-200 mesh)	8.00@15.00
(Bags extra)	
Ground talc (150-200 mesh), bulk	10.00@15.00
(Bags extra)	
Los Angeles, Calif.—Ground talc (200 Mesh)	20.00
Natural Bridge, N. Y.—Ground talc (150-200 mesh) bags	12.00@13.00
Rochester and East Granville, Vt.—Ground talc (20-50 mesh), bulk	8.50@10.00
(Bags extra)	
Ground talc (150-200 mesh), bulk	10.00@22.00
(Bags extra)	
Vermont—Ground talc (20-50 mesh); bags	7.50@10.00
Ground talc (150-200 mesh); bags	9.00@16.00
Waterbury, Vt.—Ground talc (20-50 mesh), bulk	8.50
(Bags $1.00 extra)	
Ground talc (150-200 mesh), bulk	10.00@15.00
(Bags 1.00 extra)	
Pencils and steel workers' crayons, per gross	1.20@ 2.00

Rock Phosphate

Raw Rock

Per 2240-lb. Ton

Centerville, Tenn—B.P.L. 72% to 75%	6.00@8.50
B.P.L. 65%	6.00
Gordonsburg, Tenn.—B.P.L. 68%@72%	4.50@6.00
Tennessee—F. o. b. mines, long tons, unground Tenn. brown rock, 72% B. P. L.	7.00
Mt. Pleasant, Tenn. — Analysis, .70 B.P.L. (2000 lbs.)	7.00
Montpelier, Idaho—70% B.P.L.—Crude	4.75
Crushed 2-in. ring and dried	5.00
Paris, Idaho.—2,000 lb. mine run, B.P.L. 70%	4.00
Wales, Tenn.—B.P.L. 70%	7.25@7.75
Per 2000-lb. Ton	
Barton, Fla. — Analysis, 50% to 65% B.P.L.	4.00@6.00

(Continued on next page)

Roofing Slate

The following prices are per square (100 sq. ft.) for Pennsylvania Blue-Gray Roofing Slate, f.o.b. cars quarries:

Sizes	Genuine Bangor, Washington Big Bed, Franklin Big Bed	Genuine Albion	Slatington Small Bed	Genuine Bangor Ribbon
24x12	$ 9.30	$8.40	$8.10	$7.80
24x14	9.30	8.40	8.10	7.80
22x12	10.80	8.70	8.40	9.10
22x11	10.80	8.70	8.40	9.10
20x12	10.80	8.70	8.40	9.10
20x10	11.70	9.00	8.70	8.40
18x10	11.70	9.00	8.70	8.40
18x 9	11.70	9.00	8.70	8.40
16x10	11.70	8.40	8.40	8.10
16x 9	11.70	8.40	8.40	8.10
16x 8	11.70	8.40	8.40	8.10
18x12	11.10	8.70	8.40	8.10
16x12	11.10	8.70	8.40	8.10
14x10	11.10	8.40	8.10	7.80
14x 8	11.10	8.40	8.10	7.80
14x7 to 12x6	9.60	8.40	8.10	......
	Mediums	Mediums	Mediums	Mediums
24x12	$ 8.10	$7.50	$7.20	$5.75
22x11	8.40	7.80	7.50	5.75
Other sizes	8.70	8.10	7.80	5.75

For less than carload lots of 20 squares or under, 10% additional charge will be made.
Granulated slate per net ton f. o. b. quarries, Vermont and New York, 7.50

(Continued from preceding page)

Ground Rock

Centerville, Tenn.—B.P.L. 65%	6.50
B.P.L. 75% (brown rock)	12.00
Columbia, Tenn.—B.P.L. 68% to 72%	5.50
B.P.L. 65% (90% thru 200 mesh) bulk	5.50
Morriston, Fla.—Analysis, 35% B.P.L.	12.00
Mt. Pleasant, Tenn.—B.P.L. 65@70%	5.00@6.50

Florida Soft Phosphate

Raw Land Pebble

	Per Ton
Bartow and Norwills, Fla.—B.P.L. 50%, bulk	6.00@ 8.00
B.P.L. 78%, bulk	13.50
Florida—F.• o. b. mines, long ton, 68/66% B.P.L.	3.00
68% (min.)	3.25
70% (min.)	3.50
Jacksonville (Fla.) District	10.00@12.00

Ground Land Pebble

	Per Ton
Jacksonville (Fla.) District	14.00
Add 2.50 for sacks.	
Lakeland, Fla.—B.P.L. 60%	6.00
Morristown, Fla.—26% phos. acid	16.00
Mt. Pleasant, Tenn.—65-70% B.P.L.	6.00@ 7.00

Special Aggregates

Prices are per ton f. o. b. quarry or nearest shipping point.

City or shipping point	Terrazzo	Stucco chips
Chicago, Ill.—Stucco chips, in sacks f.o.b quarries		17.50
Deerfield, Md. — Green; bulk	7.00	7.00
Easton, Pa.—Evergreen, creme green and royal green marble	$18.00@20.00	9.00@14.00
Granville, N. Y. — Red slate granules		7.50
Ingomar, Ohio	12.00@25.00	12.00@25.00
Lincoln, Neb. — Red, white, grey, in bags		30.00
Middlebrook, Mo.—Red granite; sacks	30.00@32.50	20.00@25.00
Milwaukee, Wis.		20.00@26.50
Phillipsb'g, N. J.—Green stucco dash		9.00@14.00
Piqua, O.—Marble	8.00@10.00	7.00@ 9.00
Poultney, Vt. — Roofing granules		7.50
Sioux Falls, S. D.	7.50	7.50
Tuckahoe, N. Y.	7.00@12.00	12.00
Wausau, Wis.	14.00@18.00	

Concrete Brick

Prices given per 1,000 brick, f. o. b. plant or nearest shipping point.

	Common	Face
Appleton, Minn.	18.00	26.00@34.00
Bellow Falls, Vt.	18.00	25.00
Birmingham, Ala.	13.50	27.50@45.00
Bridgeport, Conn.	31.00	32.00
Carpenterville, N. J.	16.00	35.00@65.00
Easton, Pa.	16.00	40.00@60.00
Eugene, Ore.	22.50@25.00	35.00@75.00
Rochester, N. Y.	21.00	
Friesland, Wis.	20.00	
Houston, Tex.		19.50
Omaha, Nebr.	16.00@20.00	30.00@40.00
Piqua, O.	15.00	20.00@25.00
Phoenix, Ariz.	16.00	35.00@80.00
Portland, Ore.	23.75	45.00@75.00
Puyallup, Wash.	22.00	50.00@75.00
Rapid City, S. D.	18.00	30.00@45.00
St. Paul, Minn.	15.00	30.00@35.00
Salem, Ore.	25.00@30.00	35.00@75.00
Salt Lake City, Utah	16.00	35.00@40.00
Seattle, Wash.	18.00@22.00	35.00@75.00
Springfield, Ill.	18.00	20.00@25.00
Tampa, Fla.	15.00	25.00@65.00
Wauwatosa, Wis.	13.00@14.00	30.00@42.00

Sand-Lime Brick

Prices given per 1,000 brick f. o. b. plant or nearest shipping point, unless otherwise noted.

Albany, Ga.	7.00
Barton, Wis.	9.00
Boston, Mass.	11.50@12.50
Buffalo, N. Y.	16.50
Dayton, Ohio	12.50@13.50
El Paso, Texas	12.00
Gary, Ind.	11.50@12.00
Grand Rapids, Mich.	12.00
Michigan City, Ind.	10.00
Milwaukee, Wis. (delivered at job)	13.00
Minneapolis, Minn.	13.00
Plant City, Fla.	10.00
Portage, Wis.	15.00
Redfield, Mass.	15.00
Saginaw, Mich.	11.50
San Antonio, Texas—Common	15.00
South Dayton, Ohio	12.50@13.50
Syracuse, N. Y. (delivered at job)	18.00
F. o. b. cars	13.00
Washington, D. C.	13.50
Winnipeg, Can.	14.00

Lime

Warehouse prices, carload lots at principal cities.

	Hydrate per Ton Finishing	Common
Atlanta, Ga.	19.00	16.00
Baltimore, Md.	15.00	13.00
Boston, Mass.	23.00	20.00
Cincinnati, Ohio	19.60	14.50
Chicago, Ill.	18.00	......
Dallas, Tex.	25.00	......
Denver, Colo.	30.00	......
Detroit, Mich.	15.25	13.25
Fort Dodge, Ia.	19.70	17.00
Grand Rapids, Mich.	15.65	......
Los Angeles, Calif.	30.00	30.00
Minneapolis, Minn.	29.00	22.00
Montreal, Que.	21.00	21.00
New Orleans, La.	......	17.25
New York, N. Y.	16.99	......
St. Louis, Mo.	23.20	20.00
San Francisco, Calif.	22.00	18.00
Seattle, Wash.	27.00	......
	Lump per 180-lb. Barrel (net) Finishing	**Common**
Atlanta, Ga.	2.00	1.50
Baltimore, Md.	......	12.00†
Boston, Mass.	3.35	3.10
Cincinnati, Ohio	......	12.25
Chicago, Ill.	......	1.40
Denver, Colo.	......	2.95
Detroit, Mich.	11.50†	10.50†
Los Angeles, Calif.	3.00*	3.00*
Minneapolis, Minn.	1.70	1.40
New Orleans, La.	......	1.75
New York, N. Y.	......	3.69*
St. Louis, Mo.	......	.70*
San Francisco, Calif.	......	1.90
Seattle, Wash.	3.25	2.75

*280-bbl. (net). †Per ton.

Portland Cement

Current prices per barrel in carload lots, f. o. b. cars, without bags.

Atlanta, Ga. (bags)	3.45
Boston, Mass.	2.61
Cedar Rapids, Ia.	2.21
Cincinnati, Ohio	2.35
Cleveland, Ohio	2.26
Chicago, Ill.	1.97
Dallas, Tex.	2.25
Davenport, Ia.	2.16
Denver, Colo.	2.59
Detroit, Mich.	2.17
Duluth, Minn.	1.95
Indianapolis, Ind.	2.21
Kansas City, Mo.	2.30
Los Angeles, Calif.	3.00@3.20
Milwaukee, Wis.	2.18
Minneapolis, Minn.	2.24
Montreal, Can. (sacks 20c extra)	2.40
New Orleans, La.	2.88
New York, N. Y. (includes bags)	2.35
(10c per bbl. discount in 10 days)	
Pittsburgh, Pa.	2.02
Portland, Ore. (sacks 10c ea.)	3.05
St. Louis, Mo.	2.10
San Francisco, Calif. (sacks 10c ea.)	2.73
St. Paul, Minn.	2.24
Toledo, Ohio	2.20
Seattle, Wash.	2.94
F. o. b. Seattle (including sacks)	3.50

NOTE—Add 40c per bbl. for bags.

Gypsum Products—CARLOAD PRICES PER TON AND PER M SQUARE FEET, F. O. B. MILL

	Crushed Rock	Ground Gypsum	Agri-cultural Gypsum	Stucco* Calcined Gypsum	Cement‡ and Gauging Plaster	Wood Fiber	White§ Gauging	Sanded Plaster	Keene's Cement	Trowel Finish	Plaster Board ¼x32x36" Weight 1500 lbs. Per M Sq. Ft.	Plaster Board ⅜x32x36" Weight 1850 lbs. Per M Sq. Ft.	Wallboard, ⅜x32 or 48", Lengths 6'-10', 1850 lbs. Per M Sq. Ft.
Alabaster, Mich.	3.00	4.00	......	......	......	......	......	......	......	......	......	......	......
Blue Rapids, Kan.	3.00	4.00	6.00	8.00	10.00	10.50	10.00	......	23.75	19.00	19.375	20.00	36.75
Douglas, Ariz.	......	......	6.00	13.00	......	10.50@12.00		......	......	11.50@13.50	......		
Eldorado, Okla.	......	......	......	......	10.00	10.50	10.00	......	15.00	......	27.50	29.30	39.55
Fort Dodge, Ia.	3.00	3.50	6.00	8.00@11.00	10.00	10.50	15.45@22.00	......	21.30	20.00	19.375	20.00	30.00
Garbutt, N. Y.	......	......	6.00	8.00	10.00	10.00	......	7.00	......	......	......	20.00	......
Grand Rapids, Mich.	3.00	4.00	6.00	8.00	10.00	10.00	18.50	......	27.25	20.00	19.375	20.00	30.00
Gypsum, Ohio	3.00	4.00	6.00	9.00	10.00	10.00	19.25	7.50	27.95	21.00	19.375	20.00	30.00
Hanover, Mont.	4.50	......	6.00	......	10.00	10.50	......	......	......	11.00	......	......	......
Loveland, Colo.	3.00	4.00	6.00	8.00	10.00	10.50	......	......	29.80	......	......	......	40.00
Oakfield, N. Y.	3.00	4.00	6.00	8.00	10.00	10.00	20.20	7.00+	31.25	21.00	19.375	25.00	30.00
Piedmont, S. D.	......	......	6.00	8.00	10.00	10.50	......	......	32.25	......	27.97	31.04	41.18
Plasterco, Va.	4.00	......	7.00	8.00	10.00	10.00	20.90	......	29.90	19.00	21.375	22.00	......
Southard, Okla.	3.00	4.00	6.00	8.00	10.00	10.50	10.00	......	15.00	......	26.20	28.70	30.00
Winnipeg, Man.	3.00	4.00	6.00	11.00	10.00	10.50	15.45@22.00	......	25.80	20.00	19.375	20.00	30.00

NOTE—Returnable Jute Bags, 15c each, $3.00 per ton; Paper Bags, $1.00 per ton extra.
*Shipment in bulk 25c per ton less; ‡Bond Plaster $1.50 per ton additional; +Sanded Wood Fiber $2.50 per ton additional; §White Moulding 50c per ton additional; ||Bulk; (a) Includes sacks.

New Machinery and Equipment

New Drill and Tap Chuck

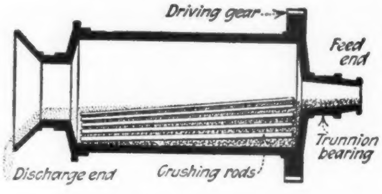
A FRICTION drive, quick-change positive safety drill and tap chuck, having a capacity of 1/8 to 3/8 in. straight shank drills and 1/8 to 3/8 in. taps has been placed on the market by the Save All Tool Co., Waltham, Mass. The new chuck, known as the No. 12 Save All, is built along lines suggested in the company's quick-change drill chuck for drills with taper shanks.

The safety device consists of a pin held in place by a pointed screw which positions in a groove in the pin. When the work exceeds the capacity of the tool, the pin shears off and can be removed by loosening the screw and inserting a new pin, a feature intended to eliminate breaking and burning of drills, taps, reamers, or other tools used in a chuck of this type. The drill or tap is held in a collet which slips into the chuck when the sleeve of the latter is raised.

Rod Type of Crushing Mill

THE Ruth rod mill, for fine crushing, as manufactured by the Denver Engineering Works, Denver, Colo., consists of a horizontal cylinder having a charge of loose longitudinal rods which crush the material between them as the cylinder revolves. The size of feed is 1½ in. to 2 in., and the product varies from 20 to 50 mesh.

A large discharge opening provides a gravity flow from the feed end. The driving end is provided with a base plate carrying both the trunnion and pinion shaft bearings, this plate having adjusting screws by which the proper alignment of the gears is maintained.



Rod mill for fine crushing

System for Unloading Bulk Material

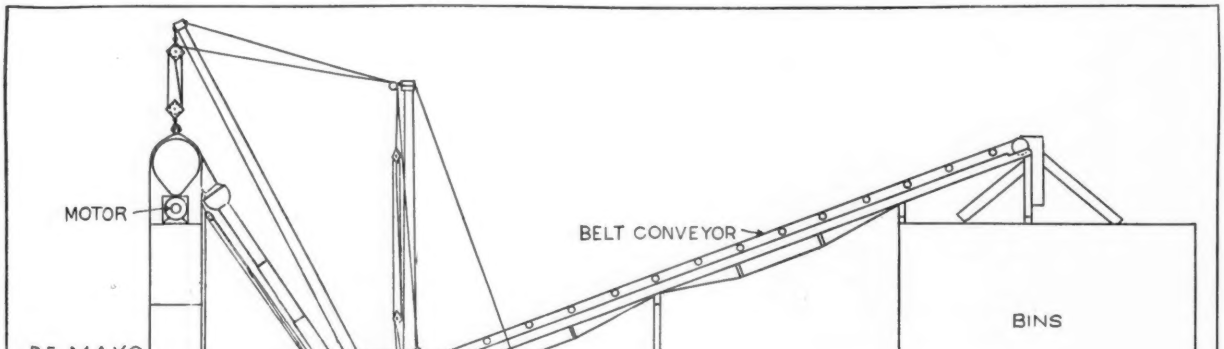
FOR unloading such material as crushed stone and sand and gravel from barges, the De Mayo portable elevators and unloaders is announced by the manufacturers, the De Mayo Coaling Co., 62 North River, New York City.

As shown in the illustration, this unloader consists of a self-contained bucket elevator which may be suspended on a barge. The driving motor is installed in the head of the elevator. The telescopic chute is intended to afford flexibility to the distribution of the material.

The unloader is suspended from a boom swinging on a mast provided with a winch for hoisting and lowering the boom and elevator. Wagons can be loaded directly from the barge or the material can be discharged to the ground, to be picked up later by the elevator and then loaded into wagons. By using a belt conveyor in conjunction with the unloader, claims the company, a proportionately greater amount of storage can be obtained.

A New Dynamite

A NEWLY developed dynamite which, it is announced, will prove an important factor in reducing explosives costs in quarrying, construction, etc., has just been perfected by the Du Pont Company. The new "powder" is known as "Dumorite" and is made with a double base of modified nitroglycerin and guncotton. It cannot freeze and does not produce headache.



System for unloading crushed stone and sand and gravel from a barge at the wharf

News of All the Industry

Incorporations

The Northern Sand and Gravel Co., Ltd., Sarnia, Ont., has been incorporated at $225,000 to deal in sand and gravel, etc.

The Sawyer Stone Co., Sturgeon Bay, Wis., has been incorporated at $250,000 by G. Stephens and T. Waller to prepare limestone for market.

The Standard Stone Co., Ltd., Windsor, Ont., has been incorporated at $40,000 by R. C. Rigg, S. E. Rigg, Windsor; R. E. Fraley, Detroit, and others to manufacture natural stone and marble for building.

The Globe Portland Cement Co., Minneapolis, Minn., has been incorporated at $2,000,000 and a permit granted to begin construction. The H. C. Strucken Co., St. Paul, are the architects and builders, and the Charles L. Pillsbury Co., Minneapolis, the mechanical engineers.

The Appleton Sand and Gravel Co., Waupaca, Wis., has been incorporated at $50,000 by R. F. Whale, Waupaca, John M. Balliett, Hugh Garvey, Jay Garvey and Walter J. Driscoll, Appleton. The plant is located in Outagamie county, near Appleton. The office is at Waupaca. President and general manager, R. F. Whale, Waupaca.

Lime

The United Fertilizer & Lime Co., Syracuse, N. Y., is planning for the installation of new crushing and screening machinery at its plant at Gouverneur, N. Y.

The Ramoth Limestone Co., operating a big commercial lime plant and quarries at Lime Rock, Conn., will install a big new boiler at the plant as soon as it is possible to place it in position. The demand for the Ramoth limestone products has been so heavy lately that increased facilities are required, and the output will be increased as soon as possible to supply the demand. The company manufactures fine grades of disinfecting lime, as well as that used for fertilizer and other more common uses.

The Lisbon Agricultural Lime Co., Lisbon, Ohio, with a capital of $50,000 has completed its organization and will erect a plant in the near future. The officers are, President, J. A. Smith, Lisbon; vice-president, John Kerr, Wellsville; secretary-treasurer, John McCaughtry, Lisbon; general manager, Frank J. Deemer, Lisbon. With the officers, the board of directors is composed of Hugh Farmer, Leetonia; William Rupert, New Waterford; Mrs. Frank Deemer, Lisbon.

The Pacific Lime and Gypsum Co., Portland, Ore., has purchased a quarter block in that city and will erect a one-story and basement warehouse on that site. The building will be 100 by 100 ft. A mezzanine floor will accommodate offices and a two-ton elevator will be installed. This company is the distributing agency for the Acme Cement Plaster Co., an Eastern corporation owning 1500 acres of lime and gypsum deposits in Baker county, six miles north of Huntington on the west side of the Snake river. The gypsum deposits extend for 2½ miles along a mountain side and a facing 125 ft. in depth has been opened for mining purposes. The property of the Acme company in Baker county represents an investment of $350,000. The Pacific Lime and Gypsum Co., is capitalized at $75,000, fully paid.

Sand and Gravel

The New York Tidewater Gravel Corp., New York City, is erecting a sand and gravel plant on the Hudson river about 40 miles from that city.

The Sac River Sand and Gravel Co., Osceola, Mo., is constructing a $30,000 plant near Osceola. President A. C. Duvall says the plant will operate on a 10 hour shift and will have a capacity of 400 tons of gravel a day.

Cement

Parkersburg, W. Va.—Plans have been completed for the rebuilding of the Biddle Concrete Co.'s plant at this city and work will start as soon as the weather permits.

John G. Lind, of the St. Mary's Cement Co., Ltd., St. Mary's, Ont., says: "Prices of material are coming down and have practically reached bottom. There has been an ample supply of labor and the efficiency has advanced 20 per cent over a year ago. The general tendency in prices is downward and goods are being sold on a close margin. The freight rates influence the price of cement tremendously. The outlook for business for this year is very encouraging and the company will be able to dispose of all the plant can

Quarries

Granite Island Quarries, Jervix Inlet, B. C., are shipping granite blocks to Australia and New Zealand.

The Kansas City Quarries Co., is the successor of the Prince-Johnston Limestone Co., with general offices in the Mutual building, Kansas City.

The Brook Trap Rock Quarry, D. R. Gillis, president, Bernardsville, N. J., will install an electrically operated crushing plant located 500 ft. away from highway route No. 16, on which 9½ miles of concrete road is to be built.

St. Charles, Mo.—The Weldon Spring Quarry Co. has been organized with a capital stock of $100,000 and the plan is to make it the largest crushed rock and lime producing plant in the state. The output will be about eight carloads of crushed rock and two carloads of lime fertilizer.

The Bromide Crushed Rock Co., Bromide, Okla., resumed operations on March 1 after a shut-down since December 15 to make repairs and enlarging the plant. The capacity of the plant is now 750 tons of crushed rock per day. The company is looking forward to an exceptionally good season, declares President A. F. Hansen.

Gypsum

United States Gypsum Co. is building six additional lime kilns at its Genoa, Ohio, plant. All equipment in connection with these new kilns will be electrically driven.

Lewistown, Mont.—The plant of the Northwest Gypsum Products Co., located some 10 miles east of Lewistown, has commenced operations. R. M. Calkins, Jr., is president, with G. J. McEntyre as vice-president and general manager. Months have been spent in completing the mill and other buildings. It is electrically operated.

Dealers

The National Sand and Material Co., Welland, Ont., has been incorporated at $100,000.

Patten Bros, Ltd., Windsor, Ont., have been incorporated at $40,000 to deal in cement, roofing, etc.

The Fairbank Block and Supply Co., Ltd., Toronto, has been incorporated at $40,000 to deal in cement, sheet metal, builders' supplies and to manufacture cement products.

National Coal & Supply Co., West Allis, Wis., has been incorporated at $18,000 by John Ermenc, Joseph Ermenc and Ralph Cheplak to deal in cement and conduct a general contracting business.

The Sanistone Products Co., Duluth, Minn., has been incorporated at $50,000 to do general contracting, manufacture sand, cement, stucco, etc., by Michele J. Toffoli, Maria Toffoli, and William P. Gibson.

C. C. Collins & Son, Madison, Wis., has been incorporated at $100,000 to manufacture all kinds of building materials, by C. C. Collins, Harold C. Collins, John F. Ross and M. P. McCullough.

The Florida Nu-Tex Brick Co., of which W. B. Coarsey, 109 Water Street, Tampa, Fla., is president, will manufacture a special cement brick, and contemplates branch factories in various parts of the state.

The Stack Construction Co., St. Louis, Mo., has been incorporated at $50,000 to do a business of general contracting and merchandising of concrete products. J. R. Stack, president; E. D. Crawford, secretary.

North Star Concrete Co., Mankato, Minn., manufacturing paving and concrete products; $100,000 capital; D. W. Radichel, president; W. O. Radichel, vice-president; Clara Radichel, secretary; Alma Radichel, treasurer.

The Granite Supply Co., St. Cloud, Minn., has been incorporated at $100,000 to quarry and manufacture granite products, by Olof Frick, president; William Campbell, vice-president, and Charles P. Ahlgren, secretary-treasurer.

Twin City Building Supply Co., Marinette, Wis., has been incorporated at $25,000 to manufacture and deal in building materials of all kinds, including cement, lime, brick, stone, gravel, sand and lumber, by Robert Rolosky, Thomas Dura and Theodore Klaver.

The Structural Gypsum Corp., New Jersey, has been incorporated at $1,125,000 to manufacture plaster, cements, etc. The incorporators are Robert A. Van Voorhis, Jersey City, and Arthur R. Oakley, Pear River, N. Y.

The Standard Material Co., Minneapolis, Minn., at $300,000, to manufacture sand, gravel, and cement products, building material, etc., by Mathew Bullis, president, John A. Nelson, vice-president; Leo L. Quist, secretary-treasurer.

The Winnipeg Sand and Gravel Co., Ltd., has been incorporated at $150,000 by T. H. Wood, C. F. Roland, D. G. T. Ross, and others, to buy and sell stone, clay, artificial stone, gravel and to operate a quarry. The head office is Winnipeg, Man.

The Little Chute Lumber & Fuel Co., Little Chute, Wis., has been incorporated at $75,000 by Joseph W. Verstegen, Adolph P. Rock and Mike Kettenhofen to deal in lumber, fuel, stone, brick, cement, granite, paints, and building materials.

Little Rock, Ark.—The Krippendorf-Tuttle White Cliffs Products Co., Cincinnati, Ohio, has been incorporated with a capital stock of $1,000,000 of which $65,000 is to be employed in Arkansas in the development of the white cliffs deposits of lime and cement in Little River county. Albert Krippendorf is president, and Simon Ross, secretary. The assets are $600,000 and the liabilities $250,000.

Concrete Products

The Lock Joint Pipe Co., Kansas City, Mo., has established a plant in Tyler, Texas, for the manufacture of concrete pipe.

The Kelly Concrete Products Co., Atlantic City, N. J., has been incorporated at $125,000 by Howard L. Carter, George E. Fredericks, Haddonfield; Wilbur V. Pike, Camden.

The American Concrete Tile & Products Co., 305 Gaither Building, Baltimore, recently organized with a capital of $250,000, has plans under way for new works, estimated to cost about $55,000. The machinery will cost approximately $25,000. Work will commence at an early date. John E. Springer is president and John W. Ritter secretary and treasurer.

Feldspar

Frontenac Floor and Wall Tile Co., Ltd., Kingston, Ont., is building a crushing plant for feldspar. Formerly the company exported it for crushing.

Manufacturers

The Ortin & Steinbrenner Co., Chicago and Huntington, manufacturers of locomotive cranes, clamshell and orange-peel buckets and coal crushers, have made arrangements with J. Ross Bates, New York and Boston, to represent them in the New England states and New York City. Mr. Ross was formerly connected with the Wonham & Good Trading Corp.

The Bucyrus Co., South Milwaukee, Wis., with Northwestern sales office at 608 Pittock Block, Portland, Ore., announces the appointment of A. R. Hance as Northwestern sales manager, succeeding L. T. Russell, who has resigned after 10 years of service with the company. Mr. Hance has been connected with the Bucyrus sales department in the Central and Eastern territories for six years and comes to the Northwest with a thorough knowledge of the company's product.

The Ball Engine Co., Erie, Pa., has changed its name to Erie Steam Shovel Co. This change was made because the company is now making exclusively Erie steam shovels and cranes, the engine business having been sold. Although the manufacture of the steam engines was discontinued about two years ago, it has been necessary to more than triple the plant capacity in the past six years to take care of shovel and crane business. This enlarged plant is now running day and night, with full force on each shift. There has been no change in the assets, policies, management or personnel of the company—the change is in name only.

R. W. Monger, Elkhart, Ind., has purchased controlling interest in the Godfrey Conveyor Co. of that city. Mr. Monger is president of the company. Other officers are B. C. Godfrey, vice-president; D. H. Herbster, treasurer, and Charles E. Clouse, secretary. The board of directors includes all officers of the company with James H. Channon, Chicago, and Fred W. Reid. The Godfrey Conveyor Co. plans to occupy a greater place in the conveyor field than before and aims to serve a wider field in supplying additional equipment now perfected and ready for the market. This new equipment includes the Godfrey standard car puller, designed to economically serve all general car moving needs, and Godfrey single drum hoist.

Personal

E. B. Nichols, formerly general superintendent of the National Lime and Stone Co., Craey, Ohio, has accepted the position of superintendent of the Lake Shore Products Co., Sandusky.

W. H. Graham, a former University of Michigan man, has been employed by the Iowa Sand and Gravel Producers' Association as secretary and offices have been established at 206 S. and L. building, Des Moines.

W. J. Malatesta has been selected as head of the building material department of the Consumers' Co., Chicago. Mr. Malatesta, a vice-president of the company, has proven his worth as head of the ice department. His personality indicates experience, ability and aggressiveness. He will be a valuable asset to the Illinois Concrete Aggregate Association because of his long experience and interest in association work. In the National Association of Ice Industries, Mr. Malatesta is a member of the executive committee and vice-president of the central division. E. J. Endres is the new assistant to the vice-president in the building material department and J. P. Coyle is the new manager of sales.

Trade Literature

Fuel Systems—Hardridge Co., 120 Broadway, New York, Bulletin No. 12, on Quigley fuel systems gives space to methods of preparing, transporting, burning fuel. It also describes the "Unit Milling Plant," and gives a list of users.

Lubricant—Under the title, "The Master Lubricant," the Keystone Lubricating Co., Philadelphia, has issued a folder describing its grease, cement mill lubrication, its Venango system and the application of Keystone to grinding mills.

Shovels and Excavating Machinery—Osgood Co., Marion, Ohio. This catalog, No. 122, is devoted to the company's latest improvements in revolving type shovels for railroad and quarry operation, ditchers, cranes, dredges. Is well illustrated.

Bargain Sheet—Gregory Electric Co., Chicago. The January issue contains the usual list of second-hand electrical machinery, together with the announcement of reductions in direct current motors and generators and alternaters and the receipt of a large stock of transformers.

Furnace Linings—The Quigley Furnace Specialties Co., 26 Cortlandt Street, New York, has issued a bulletin presenting information, with illustrations, regarding refractory linings and the use of "Hytempite" in connection with "Carbo sand" for baffles, patching boiler settings, and other purposes.

Hoists and Derricks—Bulletin HD-501 is a new 18-page publication describing P. & H. contractors' and builders' hoists and derricks, made by the Pawling & Harnischefeger Co., Milwaukee, Wis. Illustrations are included of the single, two- and three-drum types, with the principal features described. The hoists are furnished for electric, gasoline or belt drive. Structural details of the steel derricks are shown and complete tabulated data.

Car Unloaders—The Jeffrey Mfg. Co., Columbus, Ohio, has issued Bulletin No. 360, featuring the Jeffrey portable car unloader. It is so constructed as to require a minimum of space in which to operate and can readily be placed in between the car hopper door and the rails. Where conditions permit, a more permanent arrangement can be had by placing the unloader underneath the rails and thus eliminate the necessity of resetting it for each car.

Used Equipment

Rates for advertising in the Used Equipment Department: $2.50 per column inch per insertion. Minimum cnarge, $2.50. Please send check with your order. These ads must be paid in advance of insertion

Used Equipment

Rates for advertising in the Used Equipment Department: $2.50 per column inch per insertion. Minimum charge, $2.50. Please send check with your order. These ads must be paid for in advance of insertion.

RETURN TUBULAR
LOCOMOTIVE

BOILERS

WATER TUBE
SCOTCH MARINE

A LARGE STOCK OF HIGH-GRADE BOILERS OF PRACTICALLY ALL SIZES, TYPES AND MAKES, TAKEN OVER FROM DU PONT CHEMICAL COMPANY'S AND OTHER PLANTS WITH PRODUCTION RECORDS—RECONDITIONED, OFFERED SUBJECT TO ANY INSPECTION, AVAILABLE *NOW!*

"SAVE TIME AND MONEY ON YOUR POWER INSTALLATION—LET DAVIS FURNISH THE BOILERS"

LONG DISTANCE TELEPHONE
RANDOLPH 2232

J. F. DAVIS

1122-1123-1124
Harris Trust Building
CHICAGO, ILL.

FOR SALE

1—42-ton Standard gauge Baldwin Mogul, 160-lb. Steam.
1—36-ton Standard gauge Baldwin Mogul, 11' wheel base.
2—50-ton Standard gauge Brooks 6-wheel switchers, 160-lb. steam.
1—50-ton Standard gauge Shay geared locomotive.
1—42-ton Standard gauge Shay geared locomotive.
2—23-ton brand new 36" gauge Porter 6-wheel switchers, separate tenders.
2—18-ton O & S 8-wheel two-line locomotive cranes.
1—14-B Bucyrus Steam Shovel, mounted on traction wheels.

Birmingham Rail & Locomotive Co.
Birmingham, Ala.

IMMEDIATE DELIVERY

Send Us Your Steam Shovel Inquiries

No. 18K GATES CRUSHER.
50—75-Hp. Single Drum Hoists, 25 Cy. Motors
25—40-50-Hp. D. D. Hoists, 60 Cy.
Nos. 3-5-6-7½ and 8K CRUSHERS.
6- and 12-Ton Gasoline Locomotives.
10x12-in. Steam Hoist, 3 Drum with Boiler.
60-Hp. Locomotive Type Boiler.
150-Hp. Boiler, Buttstrap with Stoker, 156 lbs.
100-TON 2½-YD. ELEC. SHOVEL.
50 to 5000 ft. Steam, Belt & Elec. Comp's.
JAW AND ROLL CRUSHERS.
10—15- and 20-Ton Locomotive Cranes.
Large amount Contractors' Equip., Towers, Derricks, etc.

Send us your inquiries for Steam Engines, Centrifugal Pumps, Quarry Equip., etc.

ROSS POWER EQUIP. CO.
Indianapolis, Ind.

FOR SALE

Pulleys, shafting, hangers, elevator buckets, etc., in good condition and priced for quick sale.

THE HAHN MUSCATINE COMPANY
Muscatine, Ia.

REBUILT MACHINERY

8—Jaw Crushers—6x10 to 15 x 24.
12—Sets Geared Crushing Rolls.
2—Sets High Speed Rolls.
4—Williams Crushers and Pulverizers.
1—6-ft. Hardinge Ball Mill.
1—4-ft. Hardinge Ball Mill.
20—Air Compressors—17 to 3000 ft. capacity, Steam, Belt, Oil and Gas Driven.
30—Rock Drills, Steam and Air.
2—Jackhammers.
1—No. 5 Temple-Ingersoll Electric Air Drill.
24—Steam Engines—4 to 500 Hp.
30—Oil, Gas and Gasoline Engines—2 to 800 Hp.
1—1200 K. W. Electric Power Plant, Complete.
20—Steam Hoisting Engines.
1—40-Hp. Gasoline Hoisting Engine.
25—Centrifugal Pumps—2" to 10".
25—Steam Pumps—1" to 7" Discharge.
1—9000 Gal. Oil Storage Tank.

Write for Complete Stock List

The Machinery & Supply Corp.
Joplin, Missouri

60 x 84 TRAYLOR JAW

crusher, placed on foundations, but never put in service.
2—24"x36" type 15-B Farrell crushers.
2—24"x36" type 14-B Farrell crushers.
1—18"x24" Carrol jaw crusher.
1—16"x32" Acme jaw crusher.
1—12"x24" Reliance jaw crusher.
1—11"x20" Acme jaw crusher.
1—9"x16" Reliance jaw crusher.
1—7½"x13" Champion jaw crusher.
We can also offer other jaw crushers, gyratory crushers, elevators, screens, and general quarry equipment.

READING ENGINEERING CO., INC.
1227-A Tribune Bldg. New York, N. Y.

Machinery For Sale

DRYERS—Direct-heat rotary dryers, 3x25', 3½x25', 4x30', 5½x50' 6x50' and 7x60'; double shell dryers, 4x20', 5x30' and 6x35'; steam-heated air rotary dryers, 4x30' and 6x30'.

KILNS—Rotary kilns, 3½x25', 5x60' and 6x70', 6x100', 7x80' and 8x110'.

MILLS—6x8', 6x5', 2½x3" 3x3½' pebble and ball mills; 8x4', 6x4' and 4x4' continuous ball mills; 3' March mill; 42", 33" and 24" Fuller-Lehigh mills; 4½x20', 5x11', 5x20', 5½x22' and 6x20' tube mills; 7½x13", 9x15", 16x10" and 30x60" jaw crushers; one "Infant" No. 00, No. 0, No. 2, No. 3, and No. 9 Williams' swing hammer mills; one Kent type "G" mill; 36" and 40" cage mills; 3' and 4½' Hardinge mills; 18x12", 20x12" and 30x10" roll crushers; No. 0, No. 1 and No. 3 Sturtevant rotary crushers; one No. 2 Sturtevant ring roll crusher; 3 roll and No. 000, No. 00 and No. 0 Raymond mills; one No. 5 Telsmith breaker; one 36" Sturtevant emery mill; one 3 roll Griffin mill; 60" chaser mill.

SPECIALS—Five automatic package weighing machines; jigs; one keystone excavator; 6x8', 6x5' and 4x3' Newaygo vibrating screens, Richardson automatic scales.

Air compressors and tanks.

W. P. Heineken, Engineer
95 Liberty Street, New York. Tel. Cortland 1841

FOR RENT AND SALE

10—6-yd. rebuilt dump cars, std. gauge.
20—12-yd. Westerns, like new, std. gauge.
50—60,000-lb. capacity flat and box cars.
1—Western standard gauge spreader.
1—Osgood 18 revolving shovel, traction wheels, No. 794, ¾-yd. bucket, used 8 months.
1—Class 14 Bucyrus dragline on caterpillars, 70-ft. boom, 2-yd. bucket, used 6 months.
1—Marion 76 steam shovel, No. 3503, std. gauge.
1—P. & H. gasoline dragline and crane, caterpillars, 40-ft. boom, ½-yd. bucket, new 1921.
1—No. 2 Brownhoist four-wheel gasoline crane, std. gauge, 40-ft. boom, ½-yd. bucket, new 1921.

Locomotives

1—50-ton 18x24 in. six-wheel switcher.
1—40-ton 17x24 in. four-wheel switcher.
2—New 24-ton six-wheel Porters, separate tender, 36-in. gauge.
2—18-, 14- and 10-ton Vulcans, 36-in. gauge.

INDUSTRIAL EQUIPMENT CO.
McCormick Building Chicago, Ill.

WANTED

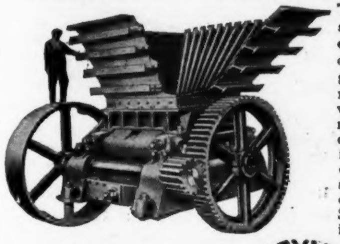
24" Symons disc crusher, late model, and first-class condition.

Williamsport Sand & Gravel Sales Co.
Williamsport, Penna.

Classified Advertising

Rates for advertising in the Used Equipment Department: $2.50 per column inch per insertion. Minimum charge, $2.50. Please send check with your order. These ads must be paid for in advance of insertion.

"PENNSYLVANIA" Single Roll Crusher



The New Series of "Pennsylvania" Single Roll Crushers take grab-bucket feed of limestone, cement rock, gypsum and similar materials,—wet and sticky,—without feeder, and make maximum reduction in one operation. All parts readily accessible. Maintenance cost lower per ton than for any other type. Massive construction — Reliable Safety Devices — Convenient adjustment.

Put Your Reduction Problems Up to Us

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Stephen Girard Bldg., Philadelphia

"NEW HOLLAND" ROCK CRUSHERS

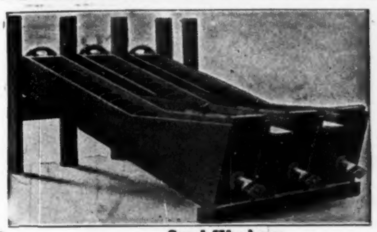
Highest in quality
Low in price

Guaranteed to crush all kinds of rock for road and concrete work, ores, coal, cinders, etc.

Write for full particulars

New Holland Machine Company

100 Franklin Street New Holland, Pa., U. S. A.



Sand Washers

9-Foot Dry Pan

Lewistown Foundry & Machine Co.

LEWISTOWN, PA.

Builders of heavy duty crushers and glass sand machinery. Glass sand plants equipped complete.

Write for prices and catalog

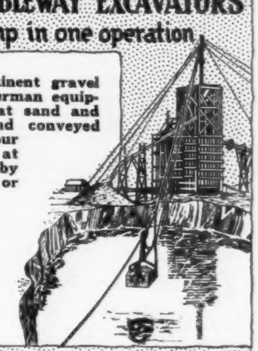
SAUERMAN DRAGLINE CABLEWAY EXCAVATORS

dig, convey, elevate and dump in one operation

Cost data furnished by prominent gravel producers who are using Sauerman equipment backs up our claim that sand and gravel can be excavated and conveyed from pit to plant by one of our drag-line cableway excavators at a lower cost per ton than by using any other equipment or combination of equipment.

Write for Catalog No. 7

Sauerman Bros.
1140 Monadnock Bldg.
Chicago
Also Mfrs. of Power Scrapers



The WILLIAMS "Hercules"

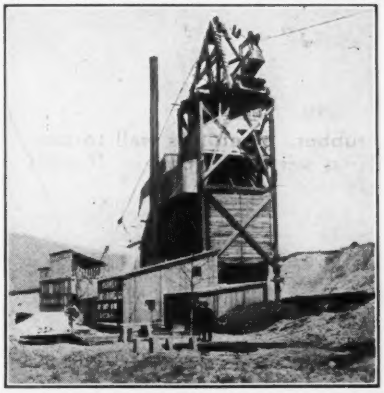
It Stands Up—*because*

TRIANGULAR CONSTRUCTION: In every WILLIAMS Clamshell, the head bearing is held perfectly rigid by the corner bars **meeting in a triangle instead of a quadrangle.** Even in the hardest digging, there is no "wobble" to a WILLIAMS. Sheaves are held perfectly in line—saving wear on sheaves and cable.

GET THE WILLIAMS CATALOG. It shows many interesting photos of every kind of clamshell work, and blue prints of the different types of WILLIAMS buckets. Glad to send you a copy—no obligation.

G. H. WILLIAMS CO., Erie, Pa., U.S.A.

WILLIAMS
QUICK-ACTING CLAMSHELLS
All Parts Guaranteed Against Breakage



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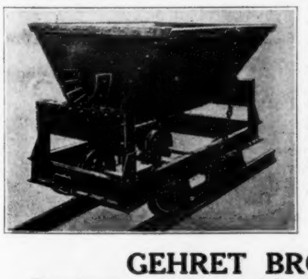
Designs and Estimates to suit your exact conditions.

Also crushing plants new and second-hand

Send for Catalogue

The Cable Excavator Company
2d and Railroad Ave.
Fernwood, Del. Co., Pa.

Strongest and Cheapest Quarry Car



on the market. That is what quarry men tell us who are using our Standard 72" Side Dump Quarry Car for 24" standard gauge track.

Equipped with Steel Pin Rockers and Brass Journals that can be replaced instantly.

Write for Complete Details and Prices.

GEHRET BROTHERS
Manufacturers of Structural Steel, Ornamental Iron Work, Quarry Cars, etc.
Bridgeport, Montgomery County, Pa.

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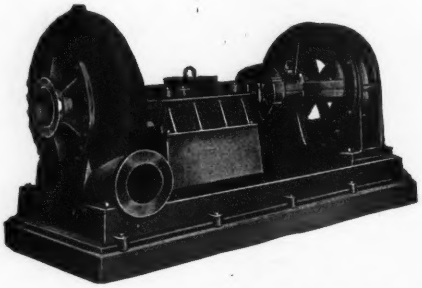
WE MAKE CARS FOR COAL, ORE, STONE, SAND, GRAVEL, CLAY AND BRICK. DRYER AND INDUSTRIAL CARS. THE WATT FACTORY IS THE LARGEST IN THE WORLD DEVOTED ALONE TO CAR BUILDING
OVER 50 YEARS' EXPERIENCE
CATALOGS
The Watt Mining Car Wheel Co.
BARNESVILLE, OHIO



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Where conditions are too severe for our standard sand pump, the above type is recommended.

It is built in sizes from 4" up, arranged for belt, motor, or engine drive.

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Baldwinsville, N. Y.

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Bulletin No. 19-B fully describes our complete line of sand and dredging pumps. Have you your copy?

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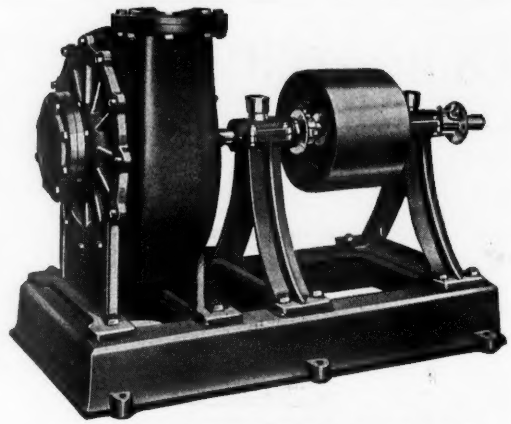
Since the Civil War Builders of Centrifugal Pumps, Hydraulic Dredges, and Steam Engines



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The durability and integrity of Lightning Sand Pumps, stamp them as the ideal pump for sand companies and contractors.

They are easy to operate, easy to adjust, and easy to replace parts. Shell and Runner made of Semi-steel.

Write for prices and complete information

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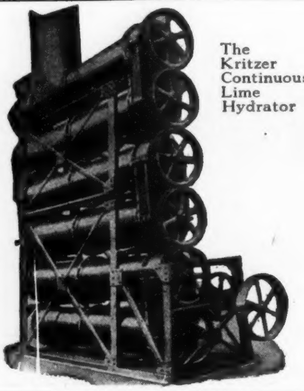

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HYDRATE

Years ago we helped our customers create a demand for their hydrate. Today the demand exceeds the supply. That's why every lime manufacturer should have an efficient, economical hydrating plant.

THE KRITZER Continuous Lime Hydrator is efficient in production and economical in operation and maintenance. Let us investigate exhaustively the local conditions peculiar to your proposition, and then apply our experience of many years and design a plant to meet those conditions.

A KRITZER plant, scientifically adapted to your conditions, will give you the best product at lowest cost

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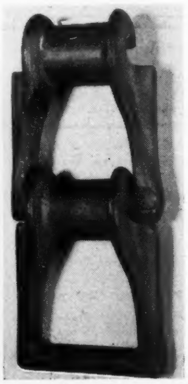

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OF EVERY DESCRIPTION

Highest Quality
Prompt Deliveries

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DERRICK IRONS, FITTINGS
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Let Us Solve Your Material Handling Problems.

All Types of
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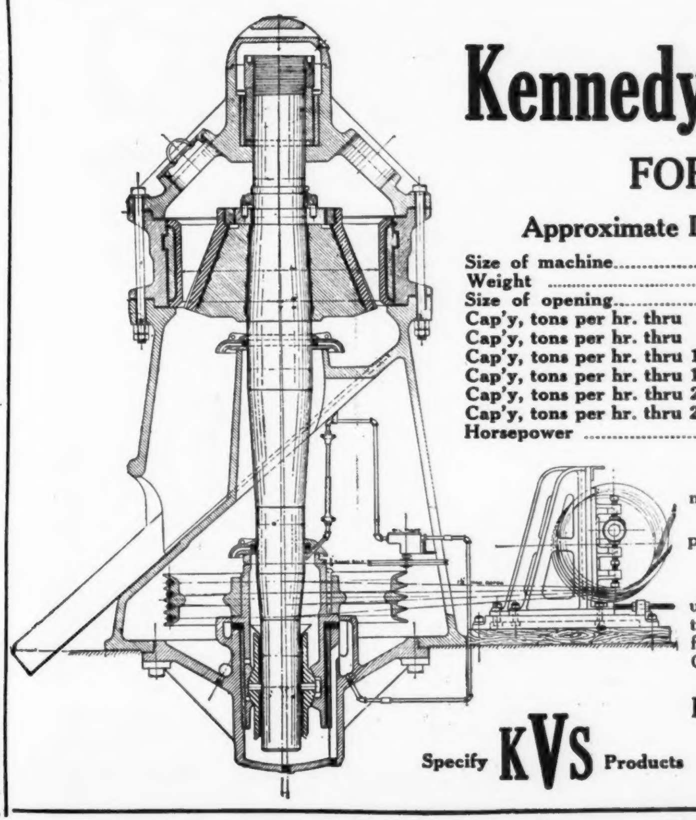
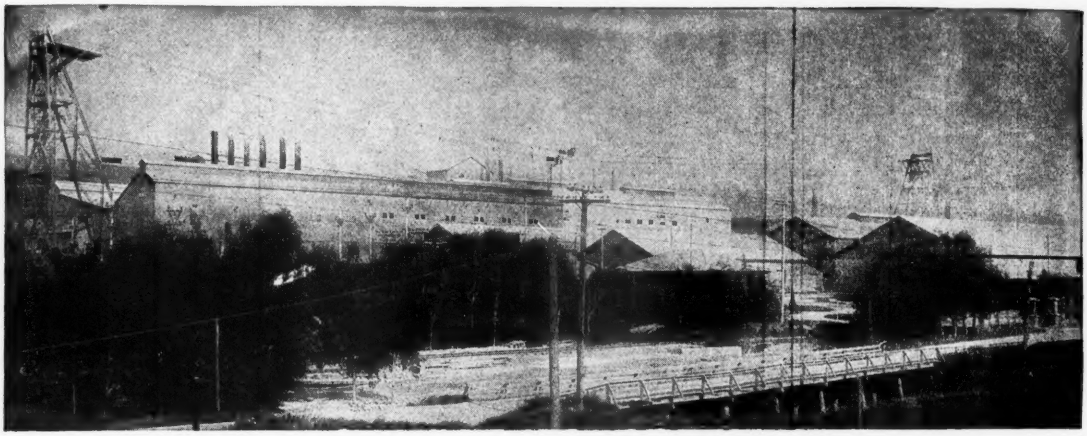


FLORY CABLEWAYS



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This Company Has Installed THREE Flory Plants

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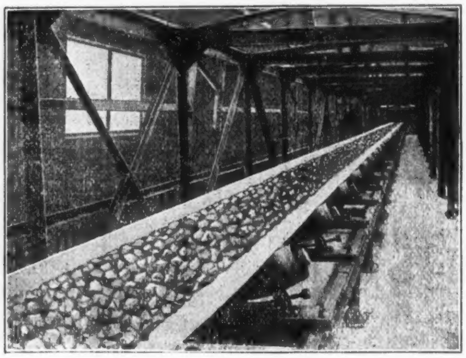
WILL INCREASE THE OUTPUT AND CUT YOUR EXPENSES



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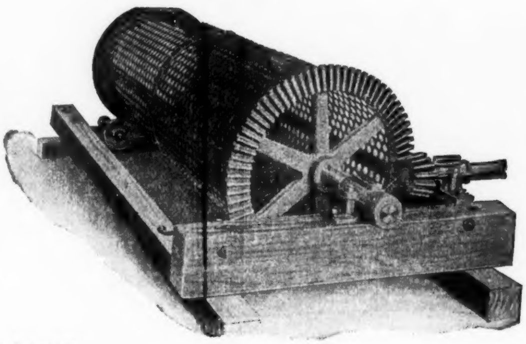

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Among the operators of quarries and sand and gravel pits who recognize the gasoline locomotive as the most dependable and economical method of hauling, the great majority are firm in the belief that the American is the standard in performance.

The American is unquestionably the speediest and most inexpensive means of hauling for pit or quarry work, and its remarkable achievements in many plants throughout the country have given it a value second to none in its field.

BUILT RIGHT RUN RIGHT

On 5 gal. of gas and a quart of oil she'll pull hard for 8 hours

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"A WILLING WORKER"

It is sometimes difficult to get the first olive out of the bottle, but after you get the first one the rest comes easy.

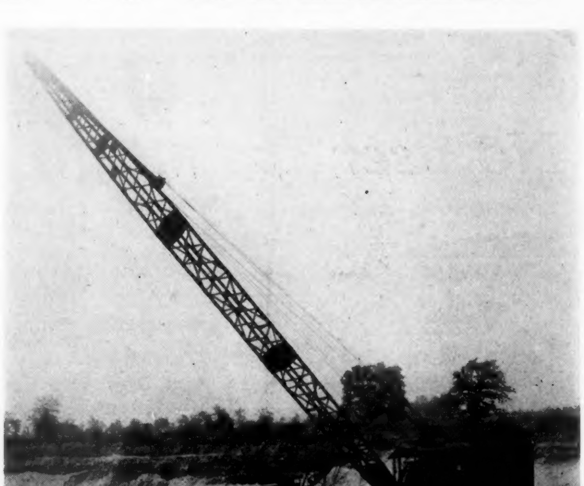
It's the same in selling Type "J" Locomotive Cranes. Sell one Type "J" and repeat orders follow.

WHY?

Because it is a regular "honest to goodness" crane, big by comparison, both in size and service.

It is human nature to like a willing worker, one that does a full day's work, day after day, without interruption or without coaxing.

Try out the type "J" and its operation will speak more convincingly than anything that can be said of its merits.



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Chicago, Illinois....812 Edison Building
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Denver, Colorado....18th and Wazee Streets
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Birmingham, Alabama....Brown-Marx Building
Boston, Massachusetts....261 Franklin Street

Buyers' Directory
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Classified Directory of Advertisers in Rock Products

AERIAL TRAMWAYS
Interstate Equip. Co., New York, N. Y.

AUTOMATIC WEIGHERS
Schaffer Eng. & Equipment Co., Pittsburgh, Pa.

BAGS AND BAG MACHINERY
Bates Valve Bag Co., Chicago, Ill.
Jaite Co., The, Jaite, Ohio.
Valve Bag Co. of America, Toledo, Ohio.

BARRELS—Lime
Draper Mfg. Co., The, Cleveland, Ohio.
International Cooperage Co., Niagara Falls, N. Y.
Sandusky Cooperage & Lbr. Co., Toledo, Ohio.

BELTING
Cincinnati Rubber Mfg. Co., Cincinnati, Ohio.
New York Belting & Packing Co., New York, N. Y.

BINS
Neff & Fry, Camden, Ohio (concrete stone)
Weller Mfg. Co., Chicago, Ill. (storage)

BIN GATES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bacon, Earle C., Inc., New York City.
Link-Belt Co., Chicago, Ill.
Sturtevant Mill Co., Boston, Mass.
Traylor Eng. & Mfg. Co., Allentown, Pa.
Weller Mfg. Co., Chicago, Ill.

BLASTING SUPPLIES
Atlas Powder Co., Wilmington, Del.
Du Pont de Nemours & Co., Inc., E. I., Wilmington, Del.
Grasselli Powder Co., Cleveland, Ohio.
Hercules Powder Co., Wilmington, Del.

BOILERS, WASTE, HEAT
Edge Moor Iron Co., Edge Moor, Del.
Freeman Mfg. Co., Racine, Wis.

BRICK MACHINERY
Besser Sales Co., Chicago, Ill.
Shope Brick Co., Portland, Ore.

BUCKETS—Elevator
Haiss Mfg. Co., Inc., Geo., N. Y. City, N. Y.
Hendrick Mfg. Co., Carbondale, Pa.
Jeffrey Mfg. Co., Columbus, O.
Orton & Steinbrenner, Chicago, Ill.

BUCKETS
Blaw-Knox Co., Pittsburgh, Pa.
Browning Co., Cleveland, Ohio.
Haiss Mfg. Co., Inc., Geo., N. Y. City, N. Y.
McMyler Interstate Co., Cleveland, Ohio.
Owen Bucket Co., Cleveland, Ohio.
Williams Co., G. H., Erie, Pa.

CABLEWAYS
Blaw-Knox Co., Pittsburgh, Pa.
S. Flory Mfg. Co., Bangor, Pa.
Interstate Equip. Co., New York, N. Y.

CALCINING MACHINERY
Atlas Car & Mfg. Co., Cleveland, Ohio.
Butterworth & Lowe, Grand Rapids, Mich.
Ehrsam & Sons Co., J. B., Enterprise, Kans.

CARS—Quarry and Industrial
Atlas Car & Mfg. Co., Cleveland, Ohio.
Easton Car & Constr. Co., Easton, Pa.
Gehret Bros., Bridgeport, Pa.
Watt Mining Car Wheel Co., Barnesville, Ohio.

CAR PULLERS
Weller Mfg. Co., Chicago, Ill.

CASTINGS—Alloy, Steel and Malleable Iron
Inland Engineering Co., Chicago, Ill.

CEMENT MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Kennedy-Van Saun Mfg. & Eng. Corp., N. Y. City.

CEMENT MILL REPAIRS
Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

CHAINS—Malleable (All Types)
Inland Engineering Co., Chicago.

COMPRESSORS, AIR
Ingersoll-Rand Co., N. Y. City.

CONVEYORS AND ELEVATORS
Caldwell, H. W., & Son Co., Chicago, Ill.

Haiss Mfg. Co., Inc., Geo., N. Y. City, N. Y.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Kennedy-Van Saun Mfg. & Eng. Corp., New York City.
Link-Belt Co., Chicago, Ill.
Smith Eng. Works, Milwaukee, Wis.
Robins Conveying Belt Co., New York City.
Stephens-Adamson Mfg. Co., Aurora, Ill.
Sturtevant Mill Co., Boston, Mass.
Universal Road Mach. Co., Kingston, N. Y.

CRANES—Locomotive Gantry
Ball Engine Co., Erie, Pa.
Brown Hoisting Machinery Co., The, Cleveland, Ohio.
Byers Mach. Co., The, Ravenna, Ohio.
Erie Steam Shovel Co., Erie, Pa.
McMyler-Interstate Co., Cleveland, Ohio.
Ohio Locomotive Crane Co., Bucyrus, Ohio.
Orton & Steinbrenner, Chicago, Ill.
Osgood Co., The, Marion, Ohio.

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American Pulverizer Co., St. Louis, Mo.
Austin Mfg. Co., Chicago, Ill.
Bacon, Earle C., Inc., New York, N. Y.
Buchanan Co., Inc., C. G., New York, N. Y.
Butterworth & Lowe, Grand Rapids, Mich.
Chalmers & Williams, Chicago Heights, Ill.
Fuller-Lehigh Co., Fullerton, Pa.
Good Roads Machinery Co., Kennett Square, Pa.
Gruendler Pat. Crusher Co., St. Louis, Mo.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Kaltenthaler, H. J., Philadelphia, Pa.
K. B. Pulverizer Co., New York, N. Y.
Kennedy-Van Saun Mfg. & Eng. Corp., New York, N. Y.
Kent Mill Co., Brooklyn, N. Y.
Lewistown Fdry. & Mach. Co., Lewistown, Pa.
McLanahan-Stone Mach. Co., Hollidaysburg, Pa.
Munson Mill Machinery Co., Utica, N. Y.
New Holland Machine Co., New Holland, Pa.
Pennsylvania Crusher Co., Philadelphia, Pa.
Raymond Bros. Impact Pulv. Co., Chicago, Ill.
Smidth & Co., F. L., New York, N. Y.
Smith Eng. Works, Milwaukee, Wis.
Sturtevant Mill Co., Boston, Mass.
Traylor Eng. & Mfg. Co., Allentown, Pa.
Universal Crusher Co., Cedar Rapids, Iowa.
Universal Road Mach. Co., Kingston, N. Y.
Williams Pat. Crush. & Pulv. Co., Chicago, Ill.

CRUSHER REPAIRS—Manganese Steel
American Manganese Steel Co., Chicago Heights, Ill.
Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

CLUTCHES
Weller Mfg. Co., Chicago, Ill.

DERRICKS
Terry Mfg. Co., New York, N. Y.

DIPPER TEETH
American Manganese Steel Co., Chicago Heights, Ill.
Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

DRILLS
The Loomis Machine Co., Tiffin, Ohio.
Sanderson Cyclone Drill Co., Orrville, Ohio.
Wood Drill Works, Paterson, N. J.

DRILLERS
Pennsylvania Drilling Co., Pittsburgh, Pa.

DRYERS
American Process Co., New York City.
Vulcan Iron Works, Wilkes-Barre, Pa.
Weller Mfg. Co., Chicago, Ill.

DUST COLLECTING SYSTEMS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

DYNAMITE
Atlas Powder Co., Wilmington, Del.
Du Pont de Nemours & Co., Inc., E. I., Wilmington, Del.
General Explosives Co., Chicago, Ill.
Grasselli Powder Co., Cleveland, Ohio.
Hercules Powder Co., Wilmington, Del.

ENGINES—Steam
Morris Mach. Works, Baldwinsville, N. Y.

ENGINEERS
Arnold & Weigel, Woodville, Ohio.
Artingstall, S. G., Jr., Chicago, Ill.
Austin Co., The, Cleveland, Ohio.
Bacon, Earle C., Inc., New York, N. Y.
Buckbee Co., J. C., Chicago, Ill.
Ehrsam & Sons Co., J. B., Enterprise, Kans.
Federal Bridge & Structural Steel Co., Waukesha, Wis.
Fuller Engineering Co., Allentown, Pa.
James N. Hatch, Chicago, Ill.
R. W. Hunt & Co., Chicago, Ill.
Randolph-Perkins Co., Chicago, Ill.
Smidth & Co., F. L., New York, N. Y.
Schaffer Eng. & Equip. Co., Pittsburgh, Pa.
Webster Mfg. Co., Chicago, Ill.

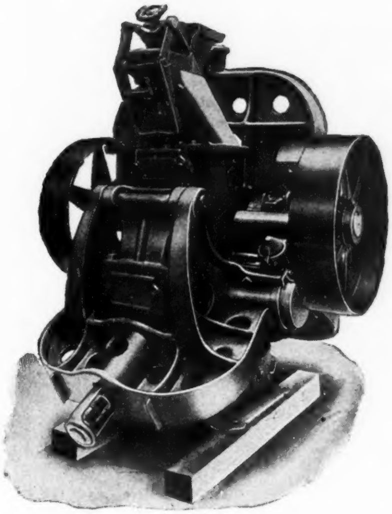
EXCAVATORS
Ball Engine Co., Erie, Pa.
Erie Steam Shovel Co., Erie, Pa.
Owen Bucket Co., Cleveland, Ohio.

EXCAVATORS—Dragline Cableway
Link-Belt Co., Chicago, Ill.
Sauerman Bros., Chicago, Ill.

EXPLOSIVES
Atlas Powder Co., Wilmington, Del.
Du Pont de Nemours & Co., Inc., E. I., Wilmington, Del.
Grasselli Powder Co., Cleveland, Ohio.
Hercules Powder Co., Wilmington, Del.

FUSES
Ensign-Bickford Co., Simsbury, Conn.

(Continued on page 76)



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Preliminary Grinder for Tube Mills

LIMESTONE .... 20 to 40 Mesh
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PERFECTECON SEPARATOR

The UNIT that has LARGER OUTPUT with LESS POWER WEAR and ATTENTION than any other.

It will be to the interest of those who operate CEMENT PLANTS to know what the Maxecon Unit will do.

Drop us a line **We will be glad to tell you about it**

Kent Mill Company
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Fine Grinding Problem

Many of the leading concerns have found the solution to their fine grinding problems on Gypsum, Cement, Talc and Soapstone, Graphite, Limestone and similar materials by installing

M U N S O N
Under Runner Buhr Mills

There is practically no limit to the degree of fineness to which these mills will grind these products. They will do the work economically and satisfactorily in every way. Solid in construction—will do away with delays and shut-down and keep out of the repair shop. Their Automatic Adjustment, Rapid Grinding and Perfect Balance Insure good results and fine and uniform grinding.

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Buyers' Directory

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Classified Directory of Advertisers in Rock Products

(Continued from page 74)

GAS PRODUCERS
Morgan Construction Co., Worcester, Mass.

GEARS
Caldwell, H. W., & Son Co., Chicago, Ill.
Plamondon Mfg. Co., Chicago, Ill.

GLASS SAND EQUIPMENT
Lewistown Fdy. & Mach. Co., Lewistown, Pa.

GRATES
The Kramer Bros. Fdy. Co., Dayton, Ohio.

GRINDING MILLS
Munson Mill Machinery Co., Utica, N. Y.

HOISTS
Flory Mfg. Co., S., Bangor, Pa.
Thomas Elevator Co., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.
Weller Mfg. Co., Chicago, Ill.

HOSE—Water, Steam, Air Drill, Pneumatic Tool
Cincinnati Rubber Mfg. Co., Cincinnati, Ohio.
Ingersoll-Rand Co., New York City.
N. Y. Belting & Packing Co., New York, N. Y.

HYDRATING MACHINERY
Atlas Car & Mfg. Co., Cleveland, Ohio.
Kritzer Co., The, Chicago, Ill.
Miscampbell, H., Duluth, Minn.
Schaffer Eng. & Equip. Co., Pittsburgh, Pa.
Toepfer & Sons Co., W., Milwaukee, Wis.

HYDRAULIC DREDGES
Morris Machine Works, Baldwinsville, N. Y.

LIME HANDLING EQUIPMENT
Weller Mfg. Co., Chicago, Ill.

LIME KILNS
Arnold & Wiegel, Woodville, Ohio.
Glamorgan Pipe & Fdy. Co., Lynchburg, Va.
Vulcan Iron Works, Wilkes-Barre, Pa.

LOADERS AND UNLOADERS
Ball Engine Co., Erie, Pa.
Erie Steam Shovel Co., Erie, Pa.
Haiss Mfg. Co., The Geo., New York City.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Orton & Steinbrenner, Chicago, Ill.

LOCOMOTIVES
Baldwin Locomotive Works, The, Philadelphia, Pa.
Fate-Root-Heath Co., Plymouth, Ohio.
Hadfield-Penfield Steel Co., Bucyrus, Ohio.
Heisler Locomotive Co., Erie, Pa.
Industrial Equip. Co., Minster, Ohio.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Lima Locomotive Works, New York, N. Y.
Porter Co., H. K., Pittsburgh, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.
Whitcomb Co., Geo. D., Rochelle, Ill.

MOTOR TRUCKS
Packard Motor Car Co., Detroit, Mich.
Pierce-Arrow Motor Car Co., Buffalo, N. Y.
Traylor Eng. & Mfg. Co., Allentown, Pa.

PACKING—Sheet, Piston, Superheat, Hydraulic
Cincinnati Rubber & Mfg. Co., Cincinnati, Ohio.
N. Y. Belting & Packing Co., New York, N. Y.

PAINT AND COATINGS
Williams, C. K., & Co., Easton, Pa.

PERFORATED METALS
Chicago Perforating Co., Chicago, Ill.
Cross Eng. Co., Carbondale, Pa.
Hendrick Mfg. Co., Carbondale, Pa.

PIPE JOINTS
Berry Flexible Pipe Joint Co., Philadelphia, Pa.

PLASTER MACHINERY
Butterworth & Lowe, Grand Rapids, Mich.
Ehrsam & Sons Co., J. B., Enterprise, Kans.

PORTABLE CONVEYORS
Haiss Mfg. Co., Inc., Geo., N. Y. City, N. Y.
Stephens-Adamson Mfg. Co., Aurora, Ill.

POWDER
Atlas Powder Co., Wilmington, Del.
Du Pont de Nemours & Co., Inc., E. I., Wilmington, Del.
Grasselli Powder Co., Cleveland, Ohio.
Hercules Powder Co., Wilmington, Del.

POWER TRANSMITTING MACHINERY
Caldwell, H. W., & Son Co., Chicago, Ill.

PUMPS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Manganese Steel Co., Chicago Heights, Ill.
K. C. Hay Press & Tractor Co., Kansas City, Mo.
Morris Machine Works, Baldwinsville, N. Y.
Traylor Eng. & Mfg. Co., Allentown, Pa.

PULLEYS
Weller Mfg. Co., Chicago, Ill.

PULVERIZED FUEL EQUIPMENT
Fuller-Lehigh Co., Fullerton, Pa.
Raymond Bros. Impact Pulv. Co., Chicago, Ill.

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N. Y. Belting & Packing Co., New York, N. Y.

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Good Roads Mach. Co., Kennett Square, Pa.
Universal Road Mach. Co., Kingston, N. Y.

ROPE, WIRE
American Steel & Wire Co., Chicago, Ill.
Leschen, A., & Sons Co., St. Louis, Mo.

SAFETY DEVICES—Goggles, Respirators, Etc.
Pulmosan Safety Equipment Co., Brooklyn, N. Y.

SCRAPERS, DRAG
Green, L. P., Chicago, Ill.
Sauerman Bros., Chicago, Ill.

SCREENS
Cross Eng. Co., Carbondale, Pa.
Good Roads Machinery Co., Kennett Square, Pa.
Haiss Mfg. Co., Inc., Geo., N. Y. City, N. Y.
Hendrick Mfg. Co., Carbondale, Pa.
Link-Belt Co., Chicago, Ill.
Simplex Screen Co., Salt Lake City, Utah.
Smith Eng. Works, Milwaukee, Wis.
Stephens-Adamson Mfg. Co., Aurora, Ill.
Stimpson Equip. Co., Salt Lake City, Utah.
Sturtevant Mill Co., Boston, Mass.
Traylor Eng. & Mfg. Co., Allentown, Pa.
Tyler Co., The, W. S., Cleveland, Ohio.
Universal Road Mach. Co., Kingston, N. Y.
Weller Mfg. Co., Chicago, Ill.

SEPARATORS
Rubert M. Gay Co., New York City.
Raymond Bros. Impact Pulv. Co., Chicago, Ill.
Sturtevant Mill Co., Boston, Mass.
Tyler Co., The W. S., Cleveland, Ohio.

SEPARATORS, MAGNETIC
Buchanan Co., C. G., Inc., New York, N. Y.

SHEAVES
Chicago Mining Sheave & Roller Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

SHOVELS—Steam and Electric
Ball Engine Co., Erie, Pa.
Bucyrus Co., South Milwaukee, Wis.
Erie Steam Shovel Co., Erie, Pa.
Orton & Steinbrenner Co., Chicago, Ill.
Osgood Co., The, Marion, Ohio.

SHOVEL REPAIRS—Steam and Electric
Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

SLATE WORKING MACHINERY
S. Flory Mfg. Co., Bangor, Pa.

SPROCKETS
Weller Mfg. Co., Chicago, Ill.

STEEL PLATE CONSTRUCTION
Hendrick Mfg. Co., Carbondale, Pa.

STORAGE BINS
Neff & Fry, Camden, Ohio

STUCCO FACINGS
Crown Point Spar Co., Inc., New York City.
Greenstone Products Co., Roanoke, Va.
The Metro-Nite Co., Milwaukee, Wis.

SWITCHES AND FROGS
Central Frog & Switch Co., Cincinnati, Ohio.
Easton Car & Constr. Co., Easton, Pa.

TANKS, STEEL STORAGE
The Blaw-Knox Co., Pittsburgh, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Traylor Eng. & Mfg. Co., Allentown, Pa.

TESTING SIEVES AND TESTING SIEVE SHAKERS
Tyler Co., The W. S., Cleveland, Ohio.

TRAMWAYS
Interstate Equip. Co., New York, N. Y.

TRANSMISSION MACHINERY
Plamondon Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago Ill.

WASHERS, SAND AND GRAVEL
Link Belt Co., Chicago, Ill.
Smith Eng. Works, Milwaukee, Wis.

WELDING EQUIPMENT
Oxweld Acetylene Co., Newark, N. J.

WHEELS, AXLES AND JOURNAL BOXES
Easton Car & Constr. Co., Easton, Pa.

WIRE ROPE
American Steel & Wire Co., Chicago, Ill.
Leschen, A., & Sons Co., St. Louis, Mo.

WIRE CLOTH
Cleveland Wire Cloth Co., Cleveland, Ohio.
Tyler Co., The W. S., Cleveland, Ohio.

Buyers' Bulletin

MANUFACTURERS OF MACHINERY AND EQUIPMENT:—These inquiries are live, up-to-date inquiries that have come direct to us from the individual in each case.

READERS OF "ROCK PRODUCTS":—This Department is for your special help and service. If you do not see what you require advertised in "Rock Products," tell us your needs and we will publish them here. There is no charge for this service.

Byers-Wilson Construction Co., 323 N. Monroe St., Peoria, Ill., advise that they are planning to open a quarry 500 to 1000 tons daily; limestone ledge approximately 100 ft. high, crusher and railroad to be at base. They want data and prices on complete equipment for such a plant.

Campbell Stone Co., Afton, Mich., want data on water and air pressure jacks, capacities up to 30 tons, to be used with 300 lb. pressure duplex pump or 100 lb. air pressure.

Tucker Sand & Gravel Co., Benton, Ark., are in the market for clamshell buckets.

The Myers Crushed Stone Co., Weeping Water, Neb., are in the market for 12 3-wheeled dump carts to be used in quarry work and must be of sturdy construction.

R. H. Miner Co., Ltd., Suite 2, 207 St. James St., Montreal, P. Q., Canada, are in the market for a No. 24 or No. 36 used Symons Disc Crusher, also used 36" x 36" or larger jaw crusher.

Ross Power Equipment Co., Merchants Bank Bldg., Indianapolis, Ind., are in the market for Nos. 9, 10 and 12 used crushers, must be in good condition. The No. 9 should be a straight drive and the 10 and 12 can be either regular or angle drive. Manganese fitted preferred.

INDEX TO ADVERTISEMENTS